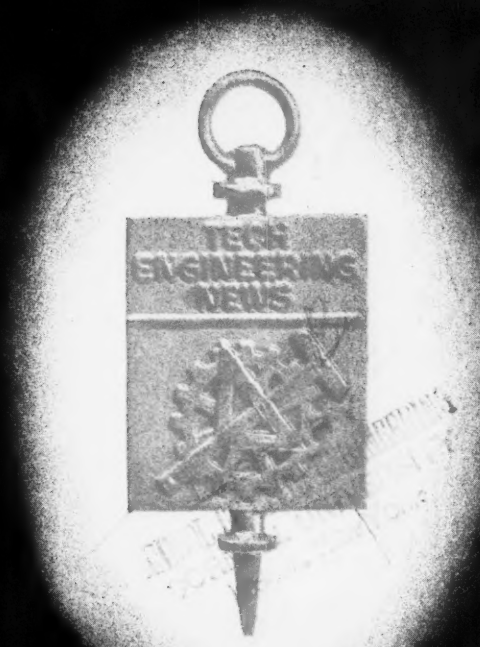
THE TECH ENGINEERING NEWS

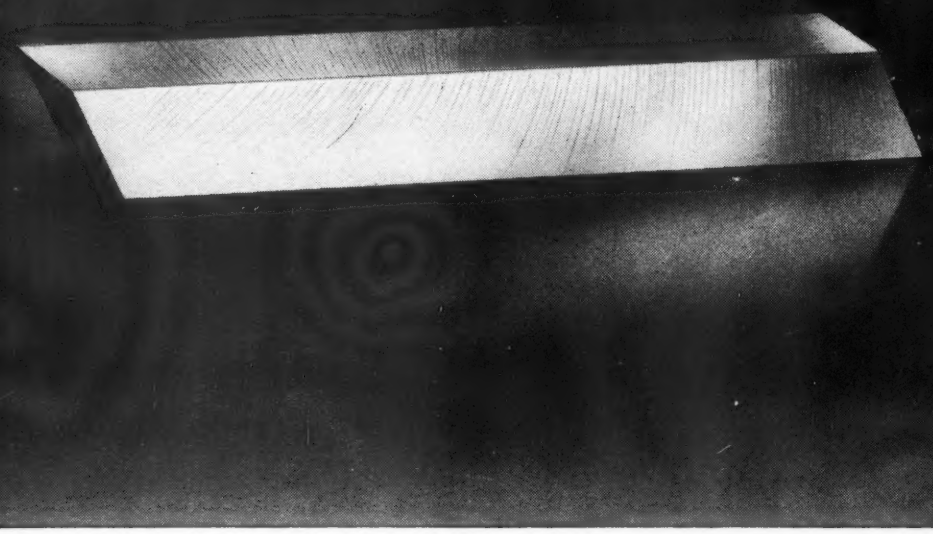
Volume XXV MAY, 1944 Number 8



TWENTY-FIFTH ANNIVERSARY

1919 M·I·T 1944

Now is the time to think about Molybdenum...



Taylor and White's great discovery which made possible high speed cutting was the greatest single development to help make mass production possible. The steel developed, commonly known as 18-4-1, served industry faithfully for over thirty years without a serious competitor.

In the early 1930's the first molybdenum high speed steels were used on a substantial commercial basis and, before the Second World War, about 25% of all tungsten high speed steels had already been replaced by molybdenum high speed steels on merit. This steady progress of logical replacement of the tungsten steels was interrupted by the war because of the tungsten shortage, when many industrial plants were forced to a sudden change to molybdenum steels.

Because of the stress of war production many concerns have never had an opportunity to satisfy themselves thoroughly as to the comparative merits of the molybdenum high speed steels. For those, in this category, who are inclined to return to the tungsten steels, we suggest a serious consideration of the following facts—molybdenum high speed steels perform as well as, or better than, tungsten steels—and they cost less.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company

MOLY

500 Fifth Avenue · New York City

KEEPING UP WITH

Electricity

BROADCASTING TIN. "Flowing" tin plate by induction heating is now accepted practice in the industry. Frequency used in the first installation was 200,000 cycles per second—and the equipment was salvaged from a discarded broadcasting unit! Incidentally, this first installation is still in daily use.

IT'S A MATTER OF SPEED. Radium gives out 1,200,000 times as much energy as the same weight of coal burned with oxygen. Even if we had plenty, however, it would probably be a poor substitute for coal, since it releases energy only one-eightieth as rapidly. Nothing that scientists have been able to do has had the slightest effect in speeding up the process.

THE SUN IS STILL SLOWER, releasing energy by a process which involves the transmutation of elements and takes between six and seven million years.

WOMAN'S WEAPON. One reason that electric irons aren't being made is that the thermostats used to control their temperature are busy on land, sea and air. They're guarding against motor trouble in tanks, fire danger in planes, overheating in gun equipment on battleships.

PEAK FLATTENERS. Resistance welders have speeded up production in thousands of war plants, but they have imposed enormous on and off single-phase loads on power circuits, often building up impossible peak demands. Capacitors are proving to be the answer, correcting the power factor to approximate unity.

THE HIGHER, THE FEWER no longer applies in radio vibrators. At high altitudes, vibrator contacts literally "boiled away" in ten hours, hence this type of radio was seldom used in airplanes. New-type vibrator, using Westinghouse-developed materials and techniques, has a life expectancy equal to that of the plane.

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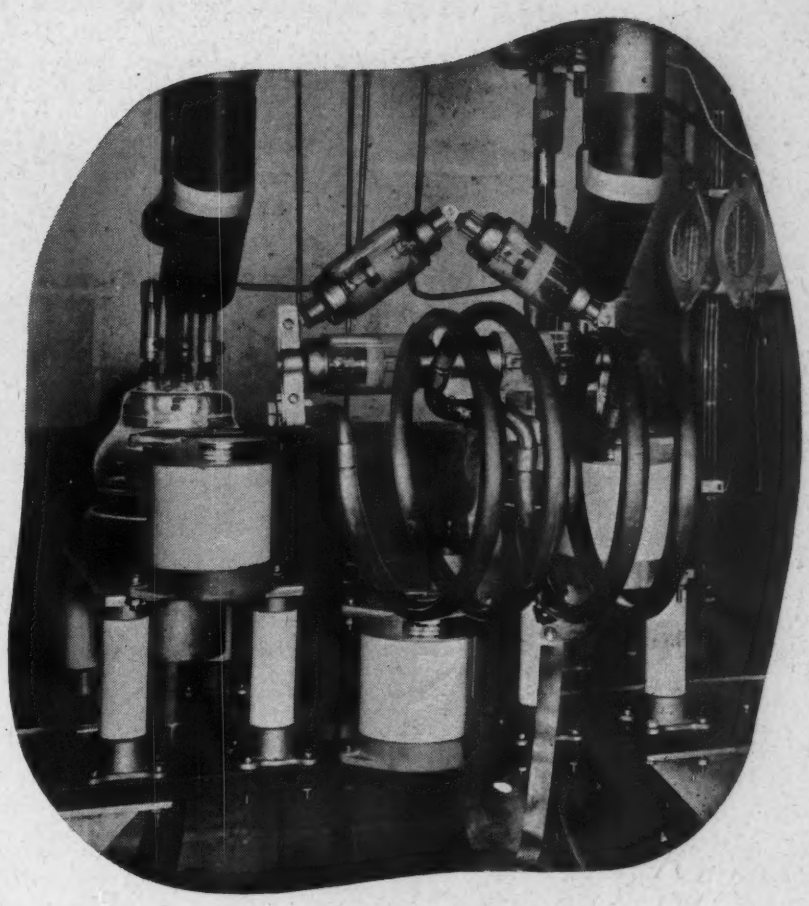
The above items are condensed excerpts from articles in the WESTINGHOUSE ENGINEER, a bi-monthly engineering review. Regular subscription price—$2.00 a year. *Special price to students—50¢.*



Plastics, plywood and electronics

This is a Westinghouse laboratory set-up for research in dielectric heating—internal heating by high-frequency radio waves. Together with induction heating—surface heating of metals by high-frequency radio waves—this process is daily finding new applications in industry.

One outstanding use of the principle of high-frequency heating is the Westinghouse development of flowing of tin on steel strip. Other important applications are in the bonding of plywood and the curing of plastics.

Dielectric and induction heating effect important savings in time and materials with attendant benefits of better control and more uniform results.

High-frequency heating is an example of electronics at work, another phase of Westinghouse leadership in electricity. Westinghouse Electric & Manufacturing Co., Pittsburgh 30, Pa.

WESTINGHOUSE PRESENTS: *John Charles Thomas, Sunday, 2:30 p.m., E.W.T., NBC. "Top of the Evening," Mon. Wed. Fri. 10:15 p.m., E.W.T., Blue Network.*

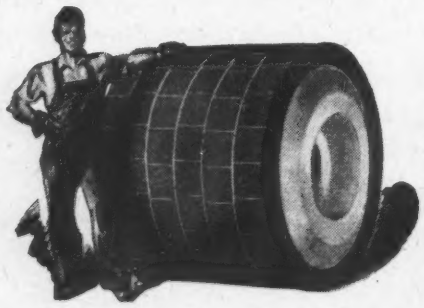
Westinghouse

PLANTS IN 25 CITIES OFFICES EVERYWHERE

An African Victory that might have hung by a tooth!

1. At one of the critical engagements of the North African campaign the American officer in command of a vital sector developed a wow of a toothache. Now he certainly would have won that victory, toothache or no toothache. But he didn't have to go into battle distracted by that pain-thumping molar because there was a dental unit right at hand to take care of him. Whether they are working close to the battle front or on your pet incisor here at home, dentists generally use tiny abrasive points such as are made by Carborundum.

2. The Carborundum Company manufactures abrasive wheels for every grinding job, from little dental points to mammoth five-foot stones that grind logs to pulp for paper making. And in between are wheels by Carborundum for all the production grinding operations that are doing so much to speed the war effort.



3 The complete abrasive and refractory service that Carborundum offers industry will be of help to you in your work in the field. When you are in industry feel free to call on us for assistance. The Carborundum Company, Niagara Falls, New York.

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ABRASIVE PRODUCTS

Carborundum and Aloxite are registered trade-marks of and indicate manufacture by The Carborundum Company.

Trains for the Modern World

Superb examples of modern progress in rail travel are the Santa Fe Railway System's famous El Capitans. For more than six years these gleaming, stainless steel, all chair car trains have spanned the 2227 miles of plain and mountain between Chicago and Los Angeles.

Combining low fares, record speed and new ideas of seating, lighting, air-conditioning and arrangement that make coach travel luxurious by day and by night, these trains are immensely popular. They have carried hundreds of thousands of travellers; have covered more than 3,200,000 miles.

Like scores of cars on other crack Santa Fe trains, and celebrated trains on many others of America's foremost railroads, El Capitans were built of stainless steel by the Edward G. Budd Manufacturing Company. They are light in weight, economical to operate, strong, unsurpassed in safety. In strenuous, continuous service, they have demonstrated the soundness of Budd ideas and construction methods for modern passenger equipment.

Trains like these are a brilliant promise for the future when materials and men for their building are released from war production.

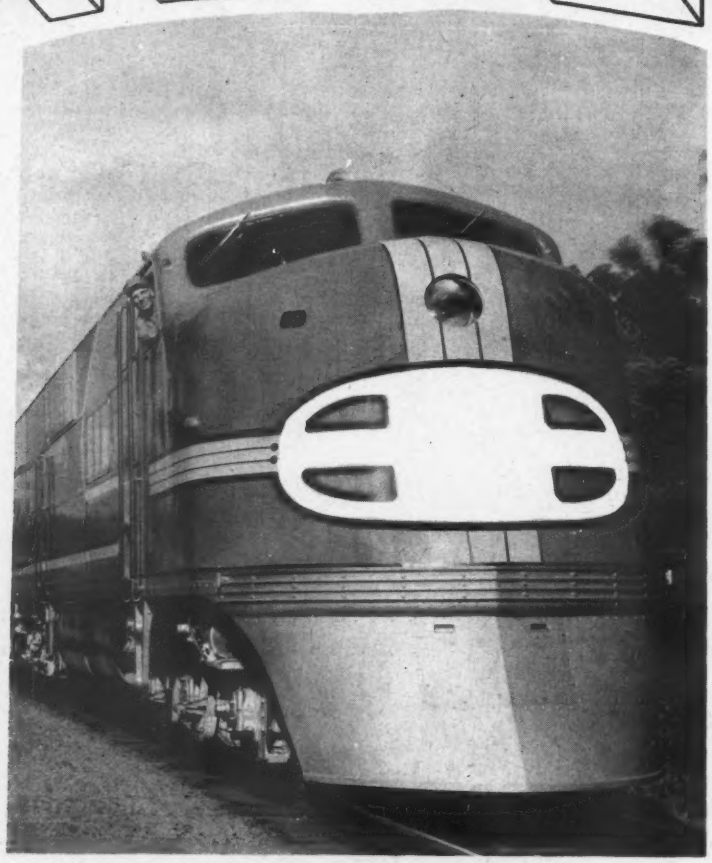
EDWARD G. BUDD MANUFACTURING CO.
PHILADELPHIA **DETROIT**
Specialists in stainless steel transportation equipment for land, sea and air. Inventors of the SHOTWELD system of fabricating hi-tensile steel.*
*REG. U. S. PAT. OFF.

Budd

Stainless steel streamliner El Capitan of the Santa Fe Railway, in Cajon Pass of the San Bernardino Mountains in California.

All America is Talking

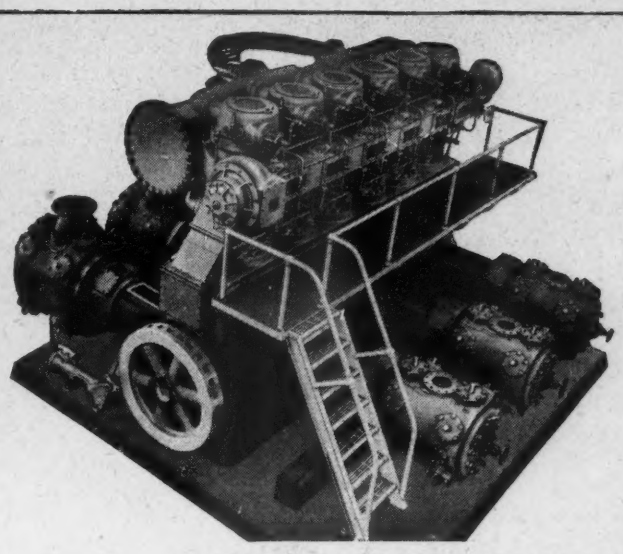
DIESEL



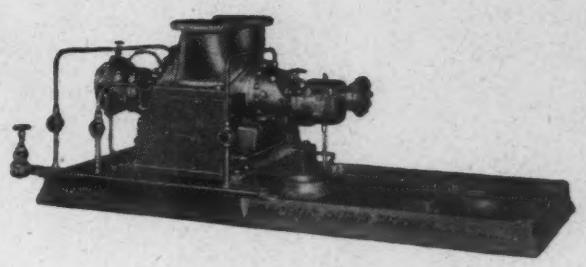
DIESEL

PERMANENT MOLD

MOOSUP, CONN.



CLARK 6 Cyl. 3000 B. H. P.
STEAM ENGINE DRIVEN COMPRESSOR



Pacific Type HV—Double Suction, Single-Stage, High Temperature, High Pressure Centrifugal Pump.

Achievements in the Field

Three thousand Horses corraled in a 20′ x 20′ space! Figuratively, that's what the Clark 6-cylinder steam driven compressor does. 3000 surging Horse Powers in a single compressor.

You'd require 30 of the old type 100 Horse Power horizontals to equal this power delivery. And then only with nearly 30 times the space and maintenance cost.

Formerly the Synthetic Ammonia industry used the old cumbersome horizontal compressor which originally was of German design. The Clark Steam Engine Driven Compressor now replaces these and does the job better and cheaper.

You'll find the same type of Clark compressor performing in the synthetic rubber and synthetic alcohol plants.

Imagine high pressure centrifugal pumps with discs whirling at 3500 R. P. M. within a third of a hair's breadth of scraping the housing—then having oil or other liquids of 850 degrees poured against those discs without expanding and jamming the works.

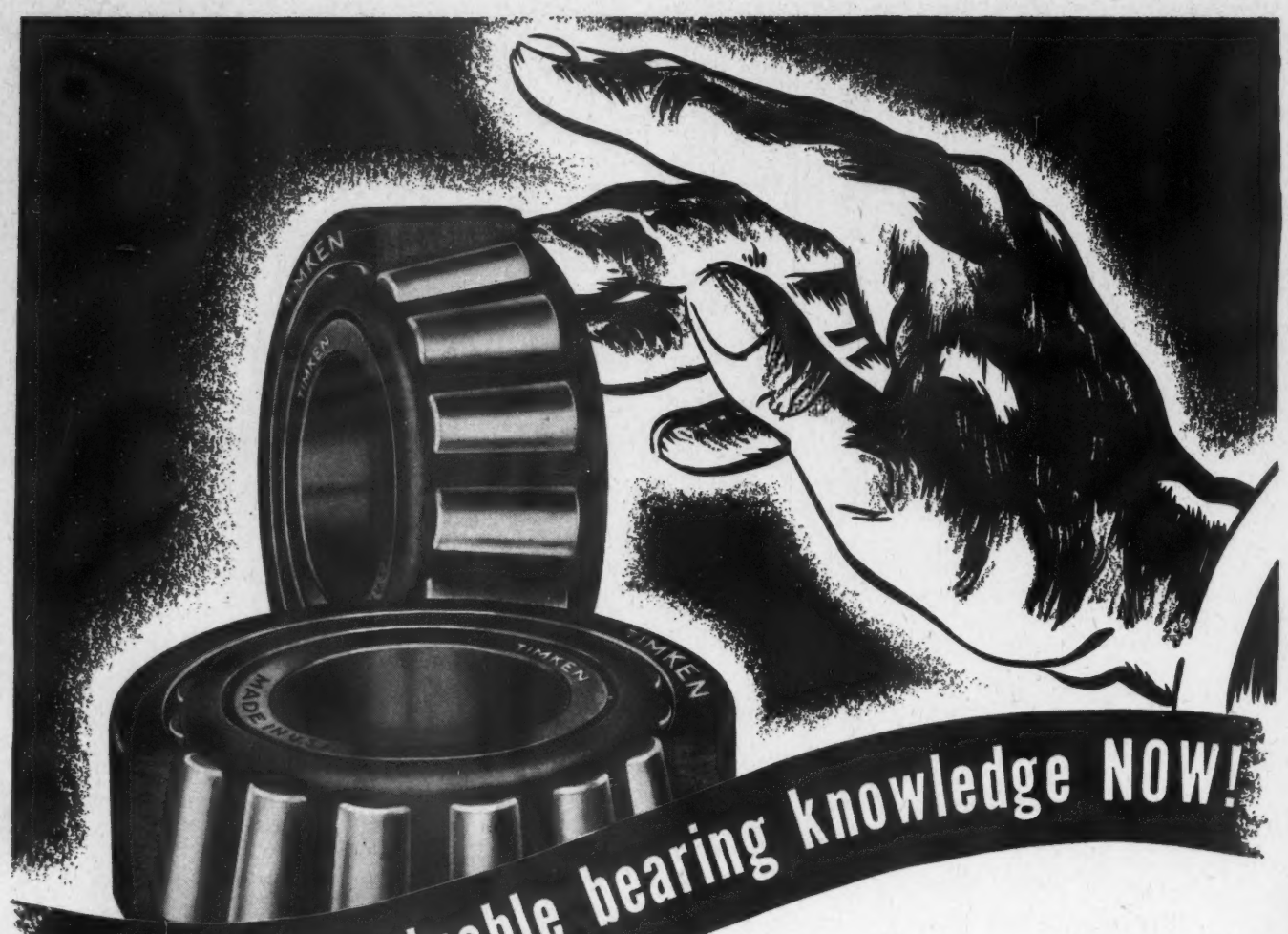
With new alloys and a revolutionary cooling system, Pacific engineers developed this new pumping technique—pumps that perform with precision, not only at 850 degrees but also at sub-zero and all the intervening degrees.

That's the kind of punishment Pacific Engineered Pumps are built to take. The world over, in oil refineries, power plants, wherever liquids, hot or cold, are centrifugally pumped, Pacifics are giving long years of economical, dependable service.

CLARK BROS. CO., INC.
Olean, N. Y.

PACIFIC PUMPWORKS
5715 Bickett St., Huntington Pk., Cal.

"Two of the Dresser Industries"



Grasp this valuable bearing knowledge NOW!

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

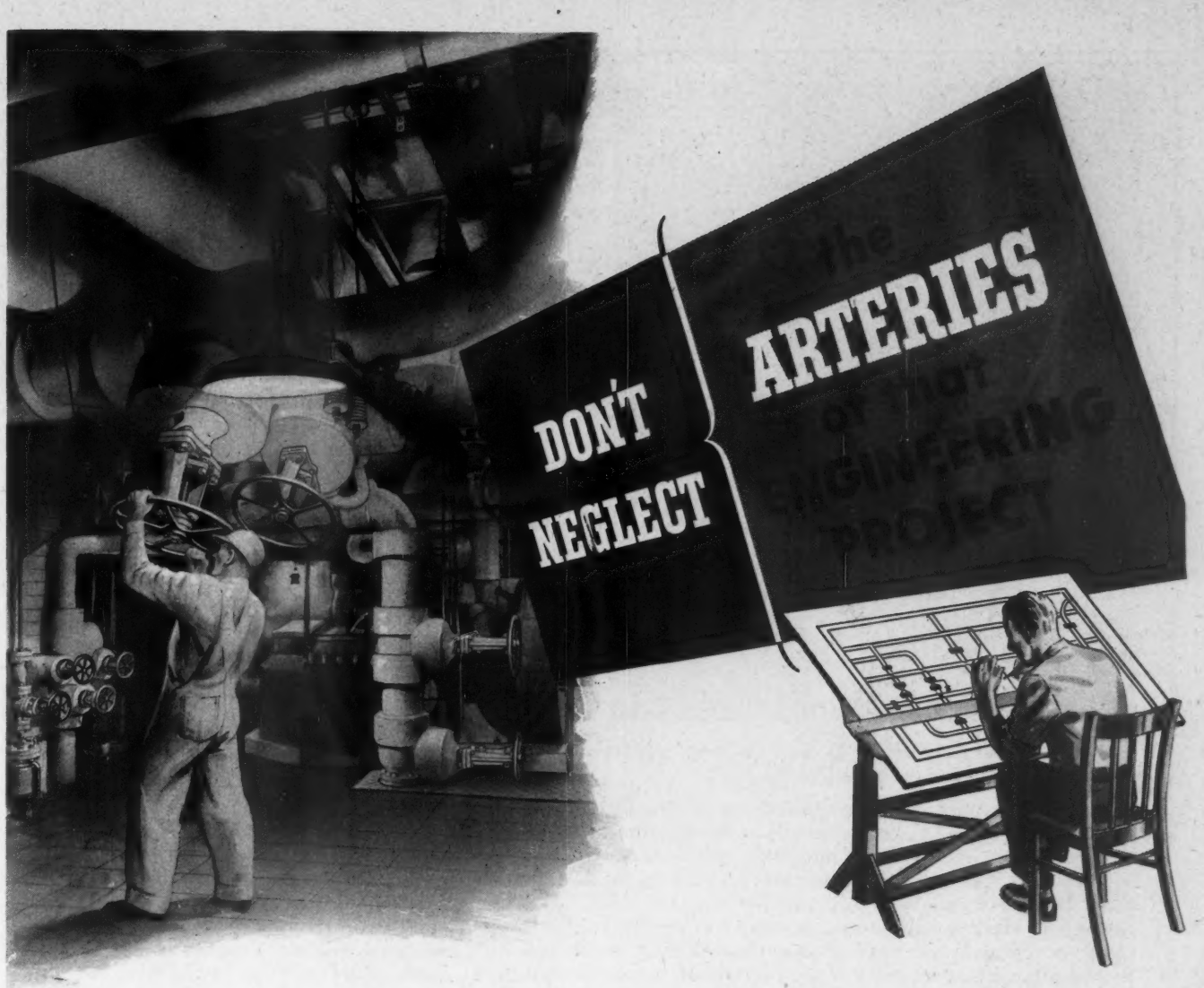
Inherent in the design of the Timken Tapered Roller Bearing is the answer to practically every bearing requirement.

The term "anti-friction" long has been inadequate as a bearing description—in fact ever since the Timken Bearing was introduced 46 years ago.

In order to fulfill every requirement a bearing must be more than an anti-friction bearing; it must also be able to carry radial loads, thrust loads, and every combination of both, as well as hold shafts in positive and accurate alignment.

All these requirements are contained within the scientific tapered design and precision construction of the Timken Bearing.

With a thorough knowledge of Timken Bearing design and application as part of your education you will be in position to solve practically any and every bearing problem you may ever encounter. Begin to acquire this knowledge now — you will be a better engineer for it. The Timken Roller Bearing Company, Canton 6, Ohio.



PIPING is an important part of almost every engineering project. When you indicate a pipe line on a drawing, think of it in terms of the pipe, the valves, the fittings, the unions, the traps that it will ultimately be translated into. Think of the metals of which it will be made—brass, iron or steel. Consider how it should be assembled—bolted, screwed or welded.

The parts that make up any piping system are many, but it will interest you to know that everything for the complete system is included in the Crane line.

By writing Crane on a piping specification, you are assured that the single source will save valuable time, all down the line. You are also certain that all parts will fit, providing simpler assembly. Long, satisfactory operation results from the high quality which, since 1855, has always characterized piping equipment carrying the name Crane.

CRANE CO., 836 S. Michigan Avenue, Chicago 5, Illinois

HERE'S ENGINEERING DATA TO HELP YOU

Crane engineers have prepared a number of important books and treatises on piping equipment and piping systems. These include the Crane Catalog, *listing more than 48,000 different piping items and containing valuable engineering data*—Piping Pointers Manual, *packed with information on piping installation and maintenance*—Flow of Fluids *and* Combating Corrosion, *two technical papers of value to anyone laying out pipe lines.*

On file for reference in Engineering Library

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

DEDICATION

It is with the greatest of respect that The Tech Engineering News this month dedicates its Twenty-Fifth Anniversary Issue to M. I. T.'s President, Karl Taylor Compton. Dr. Compton's term as President of the Institute has been characterized by progress in all directions, and it is indeed a great pleasure to salute this great educator and scientist.

Dr. Karl T. Compton

BORN in Wooster, Ohio, September 14, 1887, Dr. Compton spent most of his early life in his small, midwestern home, graduating from Wooster College in 1908 with a degree of Bachelor of Philosophy. His early career included teaching and research at Reed College in Portland, Oregon, and then Princeton, where he was assistant professor of Physics and later chairman of the department until 1930, when he was called to M. I. T.

The assumption of the presidency of the Institute in 1930 by Dr. Compton marked the beginning of a notable era in the advancement in the relationships between the engineer and the civilization in which he lives. It is one of Dr. Compton's beliefs that education in science and engineering, combined with fundamental studies in the social implications of their professions, is the best preparation for the advancement of civilization. Towards carrying out this belief, he has been instrumental in effecting many notable changes in the curriculum and structure of the Institute. He introduced the Division of Humanities, the Graduate School, and the five-year plan of study combined with industrial coöperation, and has caused a broadening and enrichment of the curriculum towards meeting the needs of industry and a changing world.

His interest in the student's welfare led to the establishment of the Graduate House (now occupied by the Navy V-12 Training Program), and before the war he often participated in student activities and encouraged the development of an intelligent extra-curricular and social life. He still takes part in student activities as much as his full wartime schedule permits.

Although a great humanitarian and college president, Dr. Compton is and always will be a scientist first. He is the author of many technical publications dealing with research in photoelectricity, ionization of gases, soft X-rays, spectroscopy in the extreme ultra-violet, fluorescence and dissociation of gases, electric arcs and other types of gas discharge. Perhaps his most important contributions to the field of science are in the fields of thermionics, the study of electron emission from hot filaments, and the investigation of matter by means of light waves. For this work he has received many awards, including the Rumford Medal, one of the most distinguished scientific awards in the world.

Besides his extensive activities as a scientist and an educator, Dr. Compton has taken active part in civil and national affairs in such ways as he could contribute to them. In the last war he was engaged in the development of submarine detector devices for the United States Army Signal Corps and was later appointed Associate Scientific Attaché to the United States Embassy in Paris. He was appointed chairman of the Science Advisory Board by President Roosevelt in 1933 to consider the relation of science to the activities of the Federal Government, and served on many other important boards and commissions before the war.

In 1939 he was appointed a member of the War Resources Board and a year later became a member of the National Defense Research Committee, operating under the Office of Scientific Research and Development. In 1942 he was one of the three members appointed by President Roosevelt to study and report on the nation's rubber reserves. At present most of Dr. Compton's time is occupied with his activities with the Office of Scientific Research and Development, headed by former Vice-President of the Institute, Vannevar Bush. Dr. Compton is engaged in extensive activities in connection with the prosecution of the war effort, most of which will never be known until after the war, but whose importance is large, indeed.

Dr. Compton is beloved and respected by all who know him. T.E.N. sincerely dedicates its Twenty-Fifth Anniversary Issue to our great President.

THE TECH ENGINEERING NEWS

PROFESSIONAL JOURNAL
OF THE UNDERGRADUATES

MASSACHUSETTS INSTITUTE
OF TECHNOLOGY

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MAY 1944

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MEMBER OF THE
ENGINEERING COLLEGE MAGAZINES ASSOCIATED
Published monthly throughout the school year, at Walker Memorial, Cambridge A, Massachusetts, by the undergraduates of the Massachusetts Institute of Technology. Entered as second class matter, at the Post Office, June 1, 1920, at Boston, Mass., under the Act of March 3, 1879. Copyright 1944 by The Tech Engineering News. Subscription per year $1.50. Foreign $1.75. One copy 25 cents.

Rang
befor
Fairchil

THIS IS M. I. T.

AERONAUTICAL ENGINEERING

By JOSEPH S. NEWELL, '19

Professor of Aeronautical Engineering

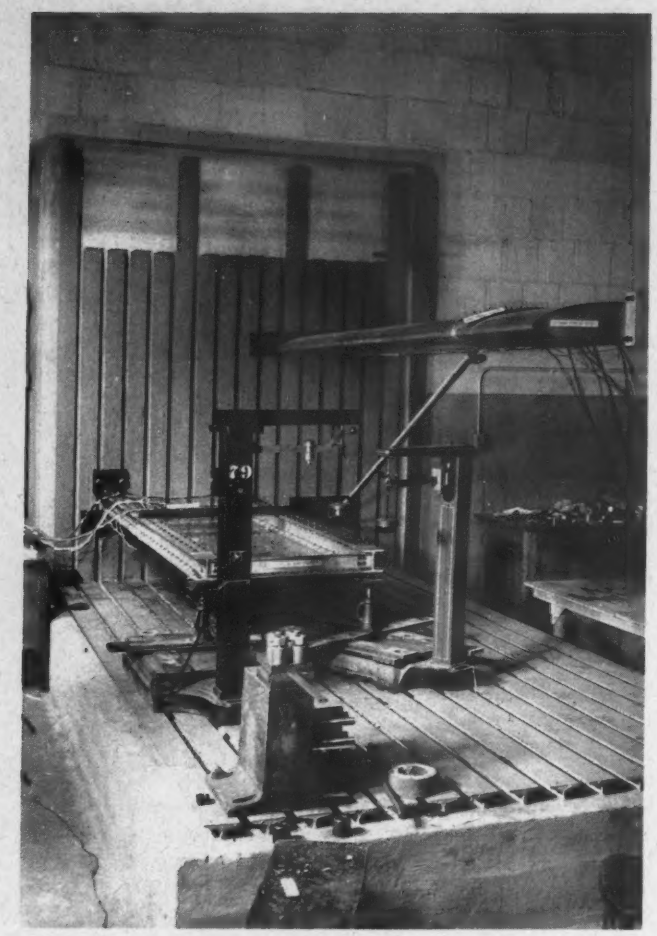
ENGINEERING has been defined as the art and science by which the mechanical properties of matter are utilized in structures and machines. A century and a half ago there were but two types of engineer, the military and the civil. Each required essentially the same knowledge of the sciences of that day as the other — mathematics, physics, and strength of materials. Consequently a man of ingenuity and judgment could attack military problems such as the construction of forts, or civilian problems such as were involved in building dams and highways, with reasonable assurance of success in either field. When the steam engine became an important source of power for operating various mechanical devices early in the nineteenth century, engineers had to acquire some knowledge of heat and its laws, some knowledge of static and dynamic systems of forces. Later in the century when electricity took its place as a means for operating machines, for providing heat, light and communications, men had to acquire a knowledge of the laws applicable to its various uses if they were to qualify as being competent to handle it. The basic sciences, mathematics and physics, were expanded to include the fundamental laws of heat and electricity, and all men who were trained as professional engineers after engineering courses were established during the early part of the century had to master these laws, along with those pertaining to mechanics and materials.

The skills required in their application, however, differed greatly, and it was found that no man was able to master the details involved in applying all of the laws to all types of engineering problems. Engineering became specialized about the beginning of the century, with civil, electrical, mechanical, mining, military and marine engineers representing the common classifications. The names and dates of establishing the various courses at the Institute are indicative of the advances made in special fields of applied science, and of the world's need for men trained in the solution of problems in those fields.

In most instances, new fields were under exploration for some years before sufficient knowledge was gained, or sufficient need for men developed, so that the training of men could be started in a new specialty. Courses in aerodynamics and airplane design, in aerostatics and airship design, for instance, were started as electives at the Institute about ten years after the Wrights had flown at Kittyhawk, but it was not until almost twenty-five years after their flight that a separate engineering program leading to a degree in Aeronautical Engineering was established in 1926. Wind tunnels and other facilities were available before that time, and a great deal of work had been done in developing and organizing the material which a man who was to design airplanes or airships would have to know. Courses had been given for some years at graduate levels, but it was not until June of 1927 that the first man received a bachelor's degree in Aeronautical Engineering. There were eight men in the class of 1928, about thirty in the class of 1929. Had it not been for the limitation on the number of students admitted to the course, imposed because of limited facilities and staff, subsequent classes would have been much larger, at least until lack of opportunities for aeronautical engineers during the depression would have reduced the number of candidates from the freshman class. Though the course is still limited as to

A Piper HE-1 Type converted ambulance plane
Piper Aircraft Corporation

Ranger airplane motors being inspected before installation
Fairchild Engine and Airplane Corporation



Department of Aeronautical Engineering, M.I.T.

BED PLATE FOR BENDING TESTS

Wires leading from specimens go to galvanometers used for determining strain by means of fine-wire electric strain gages.

enrollment, it has been possible during the past five years to accept a greater number of men. Plans for the immediate future are, however, tentative and subject to alteration to accord with the manpower requirements of the Army and Navy.

The course itself covers the physics, mathematics and chemistry essential for any engineering program the English, history and other cultural subjects required to round out the education of any professional man, the basic strength of materials, heat and machine design taken by the mechanical engineer, the fundamental structures of the civil engineer, and the aerodynamics and design problems peculiar to the airplane. It has been arranged to develop men skilled in the methods of designing airplanes from the preliminary operations of laying out tentative designs and predicting their performance characteristics, through the comparison of various models in the wind tunnel, to the designing of the various numbers in detail and the analyzing of the various parts of the structure to assure their being adequately strong. Though students wishing to specialize in the aircraft engine field are advised to take the automotive option of Course II, a man wishing to have a good background in the design of engines as well as airplanes may obtain it by choosing suitable electives during the senior year in Course XVI. Men wishing to specialize in aircraft instrument design, or in handling the particular problems brought about by the vibration of parts of aircraft, may also prepare themselves for such activities by a suitable choice of electives during the fourth year.

There are, at present, no courses arranged particularly for men interested in the operation of an airline. Most of the engineering problems encountered in this field are identical with those met by the airplane designer, so the one program answers the needs of the young man in either specialty. Progress in an airline organization, however, depends in part on engineering ability, in part on business ability, and often on a man's aptitude as a pilot. No flight training is given at the Institute, but students interested in a career with an airline may find it useful to take the "five-year" program in Aeronautical Engineering and Business Administration. This leads to both the bachelor's and master's degree, and covers the same subjects as are required by the aircraft designer, plus those involving economics and personnel problems which are so necessary to an employer or supervisor of men. While it is not possible to carry out this five-year program under wartime conditions, students may plan their schedules to complete the Course XVI program first and the Course XV subjects at the end of the war. If flight training be found necessary, it may be taken after graduation.

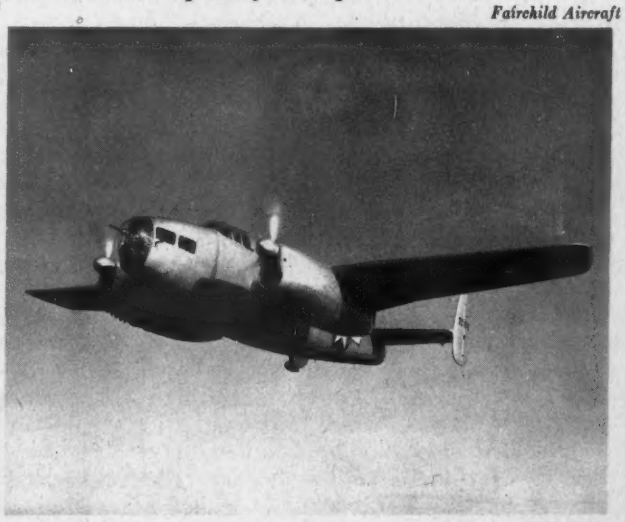
Continued on page 276

The Curtiss C-46 Commando, the largest twin-engine transport in the world. It is powered by two 2,000 hp engines, and is used by the Army for transporting jeeps, light artillery paratroops and the like.

Curtiss-Wright Corporation

A Fairchild "Gunner" Trainer, Model AT-21. Powered by two 520 hp Ranger engines, this ship has a maximum speed of 210 mph.

Fairchild Aircraft



$C_6H_8O_6$—SCOURGE OF SCURVY

By GUNTHER S. FONKIN, 2-46

Literary Associate

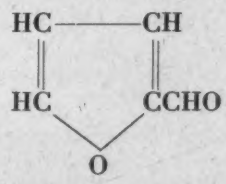
THE *Encyclopaedia Britannica* says this of scurvy: "A constitutional disease, characterized by debility, morbid conditions of the blood, spongy gums, impairment of the nutritive functions. In former times this disease was extremely common among sailors, and gave rise to a frightful amount of mortality. It is now, however, of rare occurrence at sea, the simple means of prevention being well understood." Picture, if possible, this awful spectacle of a human being rotting away. Picture too the miraculous disappearance of these signs of the disease upon drinking citrus fruit juices. It was this "miracle" which prompted investigators to attempt to isolate the material responsible for the cures.

The active material was obtained from lemon juice by King and Waugh in 1932 and found to be identical with a "hexuronic acid" which had been obtained in a similar manner some four years before. Confirmations and new experiments came thick and fast till in 1933, only one year later, the substance had been synthesized. Once the structure was known the name was hastily changed from the tentative "hexuronic acid" to ascorbic acid, or, more commonly, Vitamin C, the antiscorbutic vitamin.

And now, eleven years after this first synthesis, science has again succeeded in introducing a simplification into the process, for while the preparation of the vitamin has been a process involving bacteria at one stage, a method has been discovered of making the vitamin from sugar by an all-chemical process. This method is the result of eight years of work done by Dr. Robert C. Hockett at the Massachusetts Institute of Technology, part of it sponsored by the recently established Sugar Research Foundation.

It is significant to note that men have been trying to prepare ascorbic acid from sugar for the eleven years since the first synthesis of the vitamin. All kinds of materials have been used to attempt to convert sorbitol to xylose, for this has been the most troublesome step in the synthesis. Some have tried to use one substance, some another, but most of the attempts have been failures, probably much to the sorrow of the investigators involved. The method which finally succeeded, namely that employed by Dr. Hockett and his associates, uses furfural, an aldehyde prepared from oat hulls, for the conversion process. It is significant, also, to note that the commercial production of sorbitol and furfural, the two most important starting materials, has been under way for only a relatively short period of time, production on furfural having begun in 1922 and that of sorbitol in 1938!

Furfural, first prepared by Dobereiner in 1830 by the action of sulfuric acid and manganese dioxide on sugar, remained little more than a curiosity till 1922, when a five-hundred-pound drum of the product was prepared and sent to the Chemical Exposition in New York just to prove that production of such a quantity was possible. It is a yellow liquid a little heavier than water which can be prepared from oat hulls, which are a rich and economical source of the raw materials for its production. The companies which produce oat cereals inevitably produce furfural and its derivatives as by-products. Various uses, among them applications to plastics and to the solvent refining field, have been found for this aldehyde whose structural formula is



Sorbitol has a history similar to furfural in that it also was a chemical curiosity until comparatively recent times. However, its formula showed it to be a chain of six carbons with various convenient hydroxyl groups hooked on, thus making its similarity to glucose apparent. Since the common form of glucose is the dextro-rotary kind, and the desired form of sorbitol is also dextro-rotary, a synthesis of the latter from the former suggested itself. At this point the Atlas Powder Company, which was running the investigation, hit upon something novel in the organic synthesis field, namely electrolytic reduction of solutions of non-conducting organic substances in a conducting inorganic medium. The plan was worked out with the result that it was found that sorbitol and mannitol, its first cousin, so to speak, could be prepared on a commercial scale. The process, which looks very simple on paper, as the following equations show, is in reality a fairly complex one.

(*Continued on page 288*)

DESERT DISCOVERY

By RUSSELL K. DOSTAL, 2-46

Advertising Manager, Tech Engineering News

ONE of the less widely known industries and yet one of the most important and vital in winning the war is the potash industry. Much has been said about the phenomenal accomplishments in Detroit by the motor car industry, and in California by the aircraft industry. The South and Far West have received their rightful praise, but little or nothing is known of the Western States, particularly New Mexico, and their contribution to the war.

In the potash mines of Arizona and New Mexico the war against hunger is waged. The machines of the mine and the men who operate them are as vital in the production of food as the farmer or rancher who raises the crops.

Potash is a peacetime product that becomes immeasurably important during war. Ninety per cent of the production of potash goes to the fertilizer factories which convert the crude product into the finished fertilizers. Potash is one of the necessary plant foods and, without it, crops produce poorly. Such a condition could endanger the nation's food supply. For example an acre of land producing three hundred bushels of potatoes will remove one hundred seventy pounds of potash from the soil. Unless this deficiency is replaced, the quality and quantity of the following year's potatoes will fall considerably.

One of the country's largest potash mines, located at Carlsbad, New Mexico

Potash Company of America

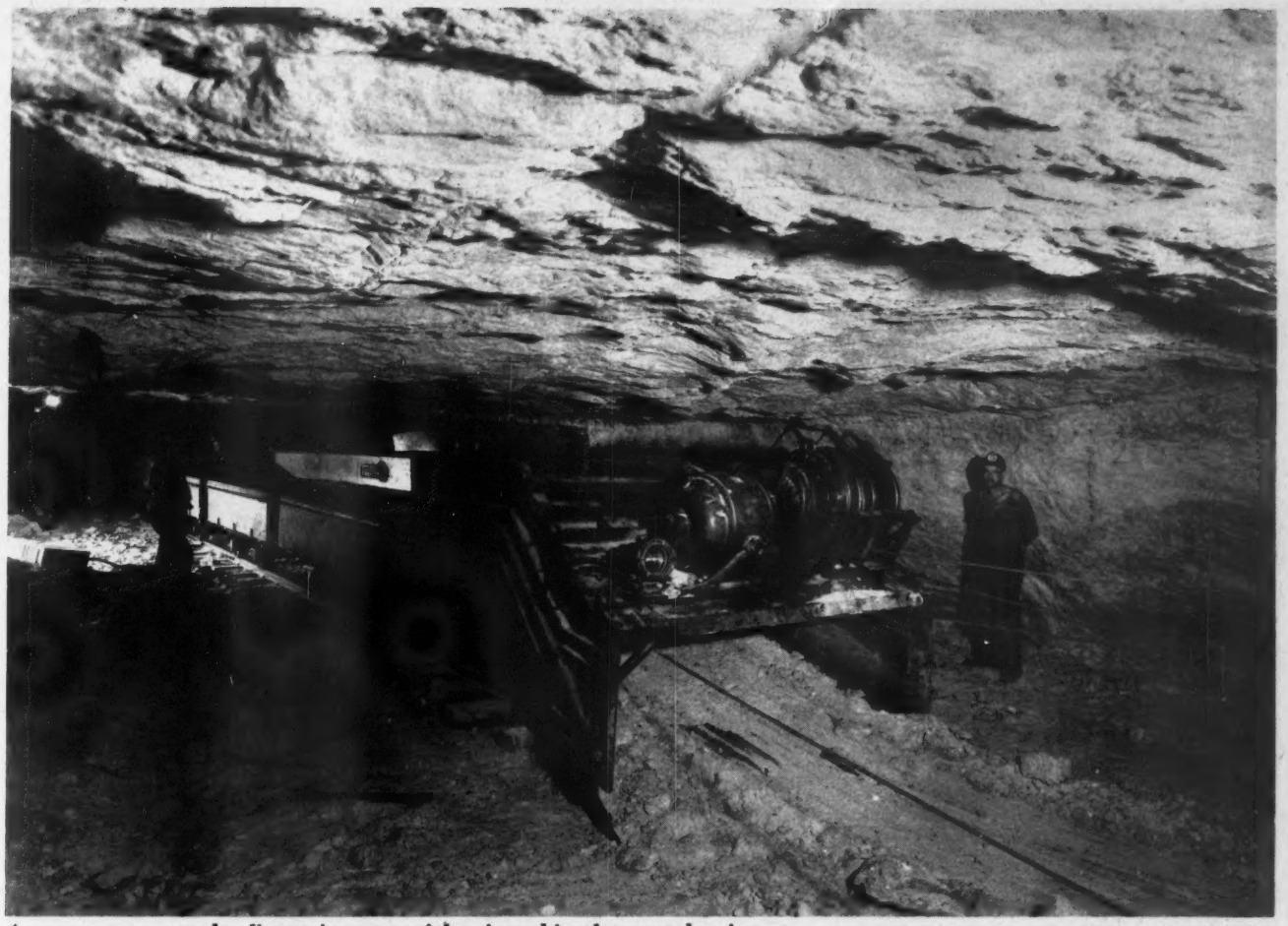
During the first World War the United States was faced with a grave potash shortage that might have affected our war effort if the war had continued. The near catastrophe was caused by the Kalisyndekat or German potash trust, which controlled the world market. At the entrance of the United States into the conflict our imports ceased. The loss sent us searching into heretofore unexploited sources, such as vegetable and animal matter, cement dusts, and the deposits of dry lake beds, for the essential potash. At the end of the war, the war plants had reached a capacity equal to half of the country's normal demands. With the close of the war and the establishment of normal relations with the Reich, came the restoration of our former imports. Few of the domestic plants could endure peacetime prices in competition with the German supply, however, and only one company, in California, could produce in any magnitude.

In 1939 the results of foresight, research, industrial development and just plain common sense on the part of the engineers and potash companies involved culminated in the shift from a peacetime to a wartime basis. There was no great confusion, no cries of shortages; the potash industry silently began its transformation.

The story of the discovery, research, and mining of the fabulous potash lodes of the West is a remarkable one. It began in 1925 when geologists and engineers, equipped with the latest drilling machinery and instruments, test drilled and worked the area around Carlsbad, New Mexico, the location where the first potash traces were discovered.

This first discovery of sylvite, a rich potash ore, happened in 1925 when crystals of the ore were found in an oil test drilling. The subsequent prospecting made it possible to obtain an approximate idea of the scope of the potash deposit. A 1,000 foot mine shaft was begun in 1929 to prove and develop the area. Mining operations began in 1931.

A second deposit of sylvite in commercial quantity was located in the Permian Basin. The Permian Basin



A scraper-conveyor loading mine cars with mineral in the potash mine — *Potash Company of America*

is an irregularly shaped subterranean area covering eastern Mexico, western Texas, and Kansas. It is believed this basin was once an arm of a huge salt water lake or sea. Today the treasure of potash is mined from this ancient lake, buried for uncounted centuries.

The potash mine is laid out similarly to a coal mine, with tunnels running from the shafts to all parts of the mine. Unlike coal mining, though, all the work that possibly can be done by machines is done. Every conceivable operation from cutting the ore to transporting the finished product is done by machine.

The mine walls in a potash mine are self-supporting and need logging and timber only where moisture threatens safety. Entrances to tunnels and intersections are also carefully timbered.

Up to the present time, no obnoxious or explosive gases have been discovered in the mines. Ventilation has been laid out in a similar fashion as in a mine where gases are released. No open flames or smoking are allowed in the mines.

The mine shafts are generally sunk a hundred or more feet below the bed so as to facilitate car dumping by gravity. The mined potash is carried by mine cars in trains to the shaft station. Cars are fed by gravity to a rotary dump and unloaded on to a feeder, and the feeder conveys the ore to a crusher which reduces the size to a five-inch maximum. The crushed ore is then measured automatically into skips which carry the ore to the surface.

Potash, like coal, is mined by blasting the solid ore from the mine walls. The broken potash is then mechanically loaded and carried to the mine shaft.

In the blasting operation, the face to be blasted is undercut eight or nine feet by a special undercutting machine. This operation generally requires 20–25 minutes. After cutting, the face is prepared for blasting. To blast a 40-foot face, 40 to 55 holes are needed. These are drilled in vertical rows of three or more with the rows 40 inches apart horizontally. Holes slightly less than two inches in diameter are drilled to a depth of the undercut. The charges are inserted and all fired at once. The powder for blasting is transported by special powder cars from magazine to the face to be blasted. Generally each face blasted requires eight hours or more to clear before loading can commence. The loaders are of two types, both mechanical, the conveyor type and scraper.

The scraper is the box type and drags in over one ton of potash when filled. The conveyor loader gathers the potash in by arms mounted on each side of an endless conveyor belt.

As is expected in all mining operations, water is encountered either in pools or by seepage through porous rock. This, however, is a blessing in disguise, for it means a source of clear water for industrial purposes. The water is pumped to the surface and is used in the processing of the ore, for water is precious on the desert where the potash mines are located.

The ore broken underground is transferred by belt conveyor to the crushing plant. The ore is crushed and fed over vibrating screens until it emerges in granular form after passing through a 10-mesh screen.

The 10-mesh material is carried by cylindrical conical-bottom bins which feed into the tube mills of the refinery. If 10-mesh material is required the raw product can be transported directly from the crusher

(*Continued on page 278*)

FOOD PROCESSING GOES TO WAR

By LEWIS W. WATERS, '10

Vice-President in Charge of Scientific Relations
General Foods Corporation

Lewis Waters, as the late Vice-President of General Foods, symbolizes the new era of the role of science in industry. A graduate chemist of the class of 1910, he taught food analysis at M. I. T. during the year following his graduation. He left the school to join the Campbell Soup Company as a chemist, but returned in 1914 as assistant in charge of the Department of Biology and Public Health. Shortly thereafter he was placed in charge of the United Fruit Company's tropical research laboratories, and in 1917 took over the direction of Du Pont's Wilmington, Delaware, experimental station. Three years later he was appointed manager of the research department of the Minute Tapioca Company, joining the General Foods Corporation as assistant to the executive vice-president in charge of research and development in 1928. He was made vice-president in charge of these activities in 1930.

Mr. Waters was a councilor of the American Chemical Society, the Institute of Food Technologists, and the Society of Chemical Industry. He was a lecturer at New York University, a consultant of the scientific committee of the War Production Board and of the advisory committee on research and development, Office of the Quartermaster General. From 1939 to 1941, he was a member of the National Research Council. He was recently nominated to life membership in the M. I. T. Corporation.

The first of this year TECH ENGINEERING NEWS *asked Mr. Waters to write an article on the role of food processing in the war. On March 31 (shortly after he had completed "Food Processing Goes to War"), after an illness of a few hours, Mr. Waters died.* T. E. N. *herewith publishes his article as a tribute to this successful executive and alumnus of the Institute.*

THE food processing business has always prided itself on its progressive attitude, its research accomplishments, and its advanced technology. The impact of war on the business, however, has served to accelerate research and technology far beyond the pace at which they moved in normal times.

With the exception of ammunition and morale, nothing is as important to the success of the war as food — processed food. It is an integral part of logistics. It moves before, with, and after the arrival of landing parties — large and small. It is a vital factor in the successful establishment of a beachhead, the effective advance of a scouting party, or the preparation for an invasion of a continent.

Without scientifically processed foods, properly packaged to withstand the rough handling which circumstances of war impose, modern fighting would be slowed down. Troop movements would depend on the amount of fresh food available in the area where the troops were quartered, plus that which could be transported from the nearest depot — which could never be far distant.

Armies today have no radial limitations because of food. Manpower can be moved in great numbers wherever strategy dictates and still be assured of adequate sustenance. In earlier wars, before the introduction of modern processed foods, armies were often defeated by reason of having permitted themselves to be drawn too far from their supply base — usually while in pursuit of a retreating foe. That military trick was old before Xenophon.

Modern warfare has caused new emphasis to be placed on nutrition and on space-saving packages that possess the quality of protecting their contents under adverse conditions. Outstanding examples of adequate nutrition and packaging are seen in Army field rations which General Foods and a number of other companies are processing and packaging in considerable quantity. These rations represent the combined findings of many food researchers, and their usefulness in sustaining life is eloquent testimony to the part they are playing in the war effort.

The processing business regards research as the very life of the industry. Through research were accomplished the miracles of canning, quick freezing, dehydration, and compressing of foods.

Incredible as it may seem, the world's food supply today is so poorly distributed that starvation would be more widespread than it is — with war disrupting supply lines — were it not for the fact that scientific processing makes possible the safe shipment of foods to far places.

While food technology has reached a high point of development even before the war, there naturally is room for improvement. Emphasis in the future, as at present, will be on nutrition, but taste and appetite appeal will always be important too.

When peace comes the developments which have taken place in these critical days of conflict will prove useful. Children, workers, and sportsmen will profit by reason of improvements in contents and packaging of rations. People who are beset by starvation due to draught or flood, blight or hurricane, will receive adequate food quickly by air transport and ships.

The people in general will profit by reason of the experiences of the men in the Armed Forces. Experiments by members of the Army Quartermaster Corps staff, working in collaboration with industrial food scientists, will provide a backlog of important information never before available.

It is known now, for example, that the type of food a pilot eats before ascending to high altitudes has a definite effect on his performance. Many case studies are being made in this field, and important findings are presaged.

One of the most successful phases of food processing is that of quick freezing. The retention of freshness in food was known centuries ago, but scientific quick freezing is a comparatively new development. Its aim is not to improve food but rather to arrest the work of nature at its most favorable point. This means that food to be quick frozen must be of prime quality to start with, and every possible precaution must be taken to preserve the quality until it is safe on the dinner table. In quick freezing the natural fresh attributes of food, including its vitamins, are retained.

That the Government recognizes the values inherent in quick frozen foods is best evidenced by the recent order which calls for setting aside for use by the Armed Forces this year, twenty-four per cent of Birds Eye's quick frozen peas, Lima beans, snap beans, spinach, and corn pack.

One advantage in quick freezing is the elimination of waste by the utilization of by-products. The accumulation of vines and pods, for example, in one central place makes possible the utilization of waste material which could not be similarly used if collected in small quantities. In normal times, for example, when Birds Eye purchases beef, the parts not used are turned back to the processor to be sold as fresh meats. Pods and vines are used as ensilage. Parts of fresh fish not used as frozen fillets are used as fertilizer. The elimination of waste cuts down on transportation and storage space, important factors under present wartime conditions.

An outstanding feature of quick freezing is its ability to retain for year round usage, fruits and vegetables that formerly could be had only in regular season. When quick freezing is done the freshness of the food is retained indefinitely and waste due to spoilage of crops due to glutted markets is avoided.

In the postwar period, when much of the world must be fed with American food, yet enough must be retained for home consumption, this crop saving feature of quick freezing will become increasingly significant.

One key to the success of quick freezing lies in the formation of minute crystals. When scientists mastered the problem of assuring uniformly small crystallization, they opened the way to success for the industry.

Quick freezing is a practical method of food preservation by means of which fresh foods can be prepared and preserved for long periods of time, and can be brought to the consumers' table in excellent condition.

Garden-fresh foods are often harvested before

Items on this shelf are some of the war food products produced by General Foods to fit special requirements of U.S. fighting men
MINUTE RICE
PREMIXED CEREAL
MINUTE RICE PUDDING
BAKER'S COCOA BEVERAGE POWDER
MAXWELL HOUSE TEA BAGS
BEAN SOUP
CREAM OF ONION SOUP
GRANULATED SUGAR

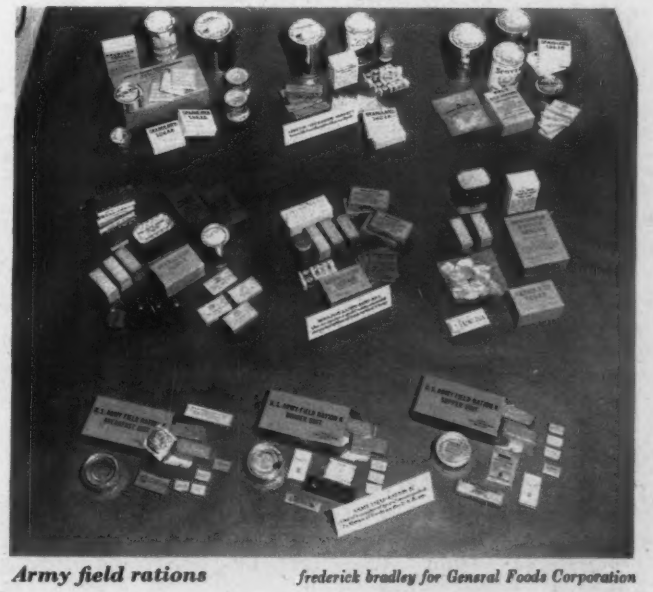
frederick bradley for General Foods Corporation

maturity and shipped long distances to market, but quick freezing permits these same foods to be sun-ripened and matured on the vine until they reach full development and nutritive content. Then without appreciable loss of time they are picked and quick frozen and their nutritive qualities held intact until they are consumed.

It has long been the objective of food processors to make food available during periods of scarcity, and also to see that it is transported to population centers where there is little land under cultivation. Quick freezing not only contributes to this goal but also preserves the appearance, flavor, and nutritive qualities of perishable foods. Products to be quick frozen are of excellent quality. Factors such as seed, variety, yield, soil, rainfall, and growing temperatures must all be suitable.

It is likewise important that quick frozen products be suitably treated for sugar in the fruits, by blanching in the case of vegetables, and by the removal of waste material from various products. Quick freezing reduces spoilage, saves shipping and storage space, and delivers the product to the consumer in airtight, moisture proof packages.

(*Continued on page 280*)



Army field rations *frederick bradley for General Foods Corporation*

HIGH VACUUM

By ROBERT MORTON GOULD, 6-45

General Manager, Tech Engineering News

MOST people think of vacuum as nothing. Naturally nothing would be the ideal vacuum, but a high vacuum is only a space of low pressure. The ranges of pressure which are considered high vacuum are from 10^{-1} to 10^{-9} mm. of mercury. Pressures are measured in the terms of the height of a column of mercury, which is 760 mm. high at atmospheric pressure. Another unit often used is the micròn, which is 10^{-3} mm.

At these low pressures the space is still not empty. As shown by the following chart, at a pressure of 10^{-9} mm. there are still 3.3×10^{7} molecules of nitrogen in a cubic centimeter.

Pressure mm. of Hg.	*No. of Molecules of N_2/c.c.*	*Mean Free Path in cm.*
760	2.5×10^{19}	8.8×10^{-8}
1	3.3×10^{16}	6.5×10^{-3}
10^{-3}	3.3×10^{13}	6.5
10^{-6}	3.3×10^{10}	6.5×10^{3}
10^{-9}	3.3×10^{7}	6.5×10^{8}

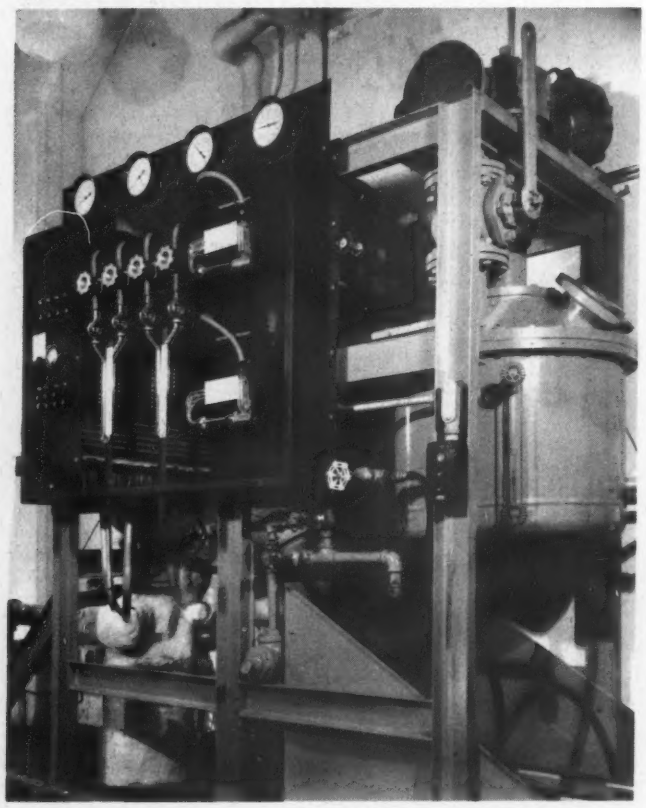
At this pressure and at a temperature of 0°C the mean free path is 6.5×10^{8} cm., that is, a molecule would travel 6.5×10^{8}, or approximately 4,000 miles, before striking another molecule. Even at one micron, the path is 6.5 cm., which means that the molecule could travel the full diameter of a pipe without hitting another molecule. Naturally the normal flow laws will not hold, since mass flow is not encountered.

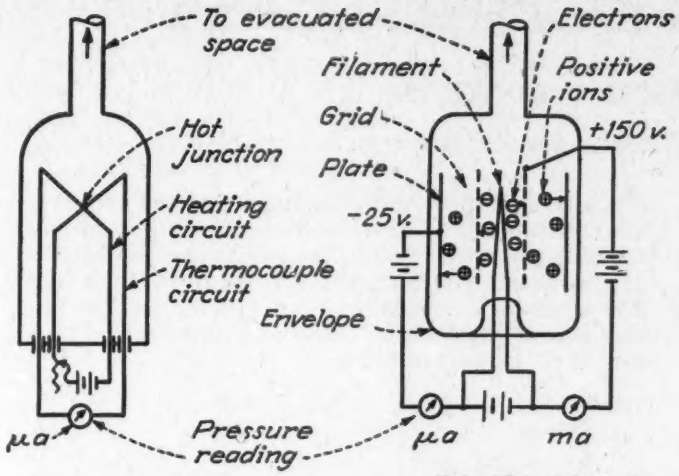
Vacuum has to be measured in order to be put to work, but the usual pressure gage is not satisfactory. The types of gages used, and their ranges, are shown by the following table:

Types	*Range*
Mercury Manometer	1.0—760 mm.
Oil Manometer	0.01—10
McLeod	10^{-5}—10
Pirani	10^{-4}—2.0
Thermocouple	10^{-4}—2.0
Viscosity	10^{-5}—10^{-3}
Knudsen	10^{-5}—10^{-3}
Ionization	10^{-8}—10^{-3}

The McLeod gage (under ideal conditions) will measure total pressures of all gases and vapors, but will not give continuous readings. The thermocouple and Pirani gages are both continuous reading, but they operate on the principle of thermal conductivity, and have to be calibrated for each gas. In the thermocouple gage, a measured current is supplied to a hot junction. Since the temperature of the thermocouple depends upon the rate heat is carried away, the temperature and current are proportional to the number of

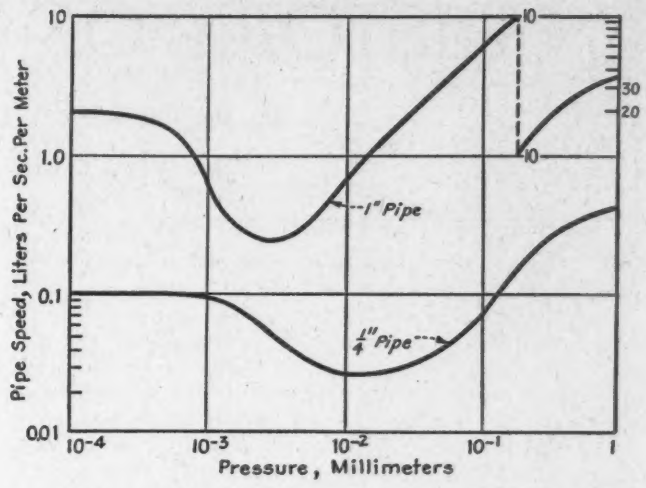
Experimental vacuum diffusion process, for dehydration. Capacity of the machine is 20 lbs. of water vapor per hour at 10–100 microns.





National Research Corporation

Circuit on the left is the National Research Corporation thermocouple gage; circuit on the right is an ionization gage.



National Research Corporation

Comparison of the speeds of ¼-inch and 1-inch pipes at micron pressures

molecules in the space. The Pirani gage is similar, being a heated resistance connected into a wheatstone bridge. For pressures below 10^{-4} mm., the ionization gage is used. This is composed of a grid at high positive potential and a plate at high negative potential. The molecules of the gas are ionized and a plate current results. This current is read on a microammeter as concentration of molecules, or pressure.

Creating Vacuums

The common method of making a vacuum is to use a mechanical pump. The minimum pressure obtainable with a reciprocating pump under ideal conditions (but with a great reduction in efficiency) is 10–25 mm. A vane type rotary pump can get as low as 10 mm., but also with reduced efficiency. The eccentric cylinder type of high vacuum pump under ideal conditions is able to reach and maintain efficiency at pressures as low as 10^{-2} mm. These pumps are difficult to keep up, since they are oil sealed and the oil must be continually purified to eliminate contamination.

The diffusion pump, developed in 1913 by Gaede in Germany, and Langmuir in the United States, has been and is being used to create continuous pressures of 10^{-7} mm. and better. This pump was until recently a laboratory instrument of glass. Now, however, it has been developed on an industrial scale.

The pump consists of a water jacketed tube from which jets of the motive vapor are issued against a conical umbrella, which directs the vapor down and out radially. The molecules of the gas to be removed are entrapped in the vapors and started in the right direction. The concentration on the lower side of the diffusers soon reaches a point where the molecules can be removed by a mechanical unit. These mechanical pumps supply what is known as forepressure. No diffusion pump can operate without a forepressure. The water-cooled walls cause the motive vapors to condense and flow back into the boiler to be vaporized again. By using multiple side jets, forepressures as high as 25 mm. can be used.

Diffusion pumps also provide much higher pumping speeds. Pumping speeds are measured in liters/second or cubic feet minute. As shown by the charts, a 2-inch pump, that is, a pump whose intake pipe is 2 inches in diameter, can pump at .01 microns 285 cfm while an 8-inch pump can handle 2,600 cfm. The mechanical pump employed in the case of the 8-inch diffusion pump has a maximum speed of 25 cfm, and cannot pump below 7 microns.

Pipe speeds are measured in volume/time/length, such as cubic feet per minute per meter. Thus the longer the pipe, the greater its impedance, and the slower the pump will operate. This must be considered when designing apparatus, since the pipe must be large enough and short enough to give a speed comparable to that of the pump.

(*Continued on page 282*)

Production model evaporator, capable of reaching 10^{-5} mm. of mercury in ten minutes. It is used for coating lens or for extraction of metals

National Research Corporation

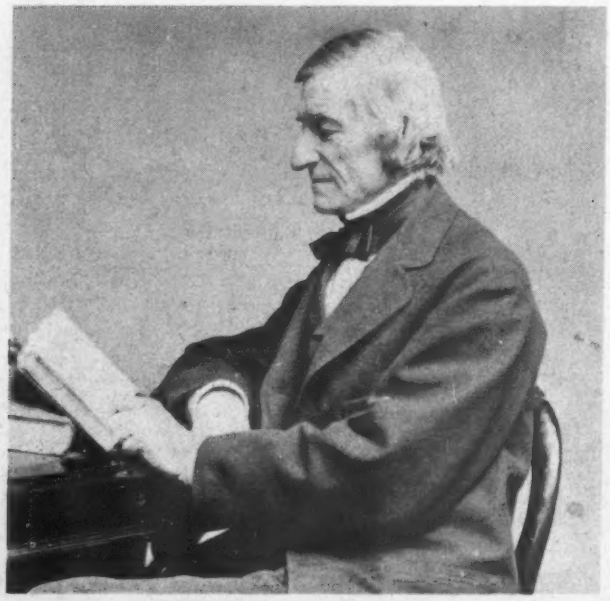
HISTORY OF TECHNOLOGY

By PROFESSOR CHARLES E LOCKE, '96
Secretary of the Alumni Association

Foreword: A feature of Freshman Camp for a number of years has been the illustrated talk by Professor Locke '96, Secretary of the M.I.T Alumni Association, to indicate to the new students some of the important mile posts in the history of Technology and to acquaint them with some of the outstanding personages who have played significant roles in the development and progress of the school. This article aims to transfer the oral presentation to the printed page for permanent record. Although titled a History of Technology, it should be understood that this short article can touch only the high spots.

WILLIAM BARTON ROGERS, the first president, conceived the plan for Technology back in 1846, but it was not until April 10, 1861, that he succeeded after many discouragements and delays in getting the charter signed. School opened in the Mercantile Library Building at 16 Summer Street, Boston, on February 20, 1865, with fifteen students and ten members of the staff. A tablet now marks the location. The first class graduated in December 1868.

Back Bay was literally a bay in early days when Boston Neck out Washington Street toward Roxbury formed the narrow link to connect Boston with Dorchester, a link so low that it may have been covered by water at extremely high tides. What is now Beacon Street was the mill dam. The Boston & Albany Railroad crossed the bay on a long trestle. The Public Garden, Boylston Street, Huntington Avenue, Columbus Avenue and intersecting streets were created when the Back Bay was filled to become made land. The legislature had granted to M. I. T. two-thirds of the block surrounded by Boylston, Clarendon, Newbury and Berkeley streets on condition that it be used for educational purposes and that buildings could not cover more than one-third of the surface. The other third of the block was given to the Natural History Association and its building still stands. On its area Technology first built old Rogers which was occupied in 1866. At that time it stood almost alone with no other buildings near it to the west or north.



William Barton Rogers
President, 1865–1870, 1878–1881

John D. Runkle, President, 1870–1878

The early years were difficult, particularly those in the late seventies when the administration would meet month after month to decide whether to close down or to try to carry on for another month. Fortunately, by making sacrifices and through the generosity of John Cummings, the Institute Treasurer, who dug down into his own pocket, the school did not close but emerged into a period of growth and expansion. The mining engineering and metallurgical laboratories bear the name John Cummings to perpetuate our great indebtedness to his generosity. .

With the upswing from the low seventies there soon came need for more room which was met by the Walker Building, located beside old Rogers. It was occupied in November 1883, and thus Rogers and Walker reached the limit of the surface in that block that could be used for buildings. The erection of the present South Union Station did away with several individual stations, including the Park Square station of the Boston & Providence Railroad and the railroad yards in the area between Park Square and Dartmouth Street. This area served to relieve the pressure for further expansion of M. I. T. so that in 1890 substantial brick buildings known as the Engineering and Architectural buildings were erected on Trinity Place. Subsequently there appeared the Pierce building, named after Henry L. Pierce a as generous donor, whose name is now perpetuated on the Massachusetts Avenue facade in Cambridge. Finally on the area around the present University Club there stood on Trinity Place the fine block of Engineer-

ing A, Engineering B and Pierce with a little two-story brick extension of temporary construction called Engineering C. Also adjacent and facing on Clarendon Street was the one-story temporary brick Lowell Building, housing the electrical engineering department. In addition there was the gymnasium on Exeter Street in the back end of the railroad yard and the wooden building on Garrison Street, called the shops, where the mechanic arts were taught. It was in the latter building that the first Technology "Commons" was instituted under President Pritchett, where not only was food obtainable but beer could be drunk.

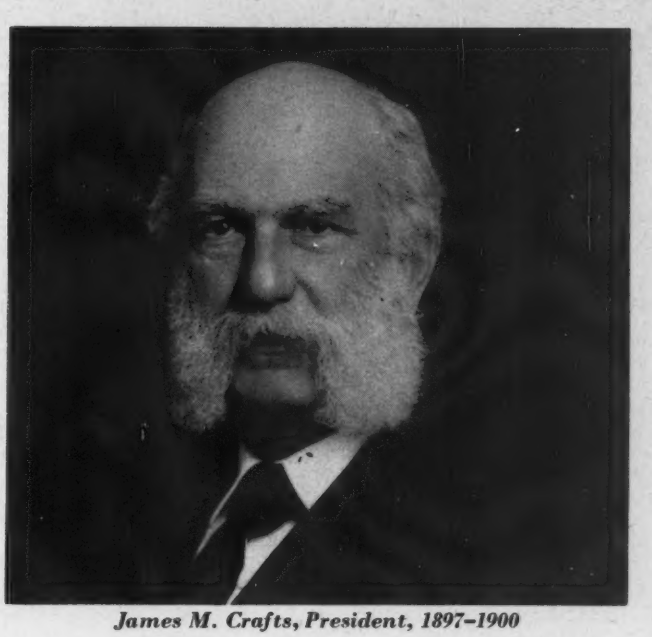
Even before 1910 it had become evident that Technology could not expand further in the Back Bay area unless it went up in the air like the University of Pittsburgh. Many sites were considered, and one in Brookline was much favored, but the final choice was the present location in Cambridge. First only the area

Francis A. Walker, President, 1881–1897

east of Massachusetts Avenue, down to and including the President's house was acquired. Later the even larger area west of Massachusetts Avenue was acquired and an additional frontage on Memorial Drive east of the President's house, so that there should be no more worries about space for long years to come.

The move across the river on the famous barge *Bucentaur* was made with much pomp and pageantry in 1916. The Mining Building (Building 8), was not completed until 1917 so that the Mining Department did not leave its quarters in the basement of old Rogers until that year. The Architectural Department did not move at the time, but took over all of old Rogers and did not come to Cambridge until 1938 when the new Rogers was ready for it. Walker Memorial, which was made possible through contributions from the rank and file of the alumni, was not ready until 1917. The President's house was built in 1916, but the adjacent dormitory building or Senior House (Ware, Atkinson, Runkle, Holman, Nichols, Crafts) were not occupied until 1917.

The wisdom of the move to Cambridge and the acquirement of ample space for growth was soon demonstrated as calls came for further growth. Thus, the Bemis dormitory unit rose in 1924, the Goodale and Walcott units in 1927, and the Munroe, Hayden and Wood units in 1930. The Riverbank Hotel was purchased and became the graduate house in 1938, and



James M. Crafts, President, 1897–1900

the Bexley Hall apartments were bought in the same year. Additions to the original educational group comprise the Guggenheim Aeronautical Building 33 in 1928, the Eastman Research Laboratory Building 6 in 1933, the Homberg Infirmary in 1928, the Sloan Automotive Laboratory Building 31 in 1929 and 1940, the Wright Brothers Wind Tunnel Building 17 in 1938, the new Rogers Building 7 in 1938, and various small units and additions scattered over the area back of the main buildings. This list does not include the vast amount of floor space in the new buildings, both permanent and temporary, which, to meet the war's demands for research, have sprung up since the war began until now the only open spaces remaining in the original lot are that between Building 6 and the dormitories and the little area behind Building 10.

The Architectural Department occupied old Rogers on Boylston Street from 1916 to 1938. Over a long period the Institute had been getting the original restrictions removed and securing releases by abuttors of any rights of light and air that had accrued to them because of the original restrictions on the building.

(*Continued on page 272*)

Henry S. Pritchett, President, 1900–1907

AFTER TWENTY-

Presenting Our Silver

BOB GOULD, OUR GENERAL MANAGER, CHECKING UP

WITH this issue THE TECH ENGINEERING NEWS completes its first quarter-century of publishing. It would thus seem, to quote the oft-quoted Walrus, that "the time has come . . . " to call a brief halt and take stock of just what has been accomplished in these twenty-five years, why and how it was accomplished, and by whom.

Bowing deeply to convey its sense of humility and gratitude THE TECH ENGINEERING NEWS acknowledges the fact that it owes its humble beginnings to *The Tech*, then as now the school's weekly newspaper. Anglophobes will doubtless be glad to add another indictment against the British by learning that the whole idea grew out of an innocent jibe made at *The Tech* by an Englishman who was visiting M. I. T. back in 1919. It seems that he saw a technical article on wireless telephony in *The Tech*, and commented that such a fine piece of writing was richly deserving of a "more respectable" publication than *The Tech*. It would further seem that in those days the gentlemen who were running *The Tech* were devoid of a sense of humor and took this to heart. Or at least two of them did. They were Robert St. Laurent and Hazen Pratt. History does not record whether or not they actually thought that their English friend "had something there." But goaded or inspired as the case may have been, they set about organizing THE TECH ENGINEERING NEWS. That the magazine has survived for twenty-five years is testimony to their ability, and perhaps even to the Britisher's insight.

During its first year T. E. N. was a "subsidiary" of *The Tech*, and the two publications functioned as one, the T. E. N. staff being for the most part boys who "doubled in brass" while working on the staff of *The Tech*. It was not long, however, before the child became father to the parent, or put somewhat less prosaically, got a little too big for its britches. This resulted at the end of the first year of publication in a separation of *The Tech* and THE TECH ENGINEERING NEWS.

Seemingly unsatisfied with its new-won independence, T. E. N. almost immediately proceeded to get itself tied down to a definite set of rules and standards which were then being formulated for collegiate engineering magazines by the Engineering College Magazines Associated. In fairness to those involved, though, it is necessary to mention that the E. C. M. A. was organized and founded by THE TECH ENGINEERING NEWS.

These pioneers of boundless ambition also went so far as to formulate a Constitution for T. E. N. This tied the hands of succeeding Managing Boards so thoroughly that they have been able to maintain T. E. N. in its preëminent place in the field of college engineering journals right up to the present day. It bears witness to the astuteness of the framers of the T. E. N. Constitution that through a quarter century only minor modifications have been necessary, except for one brief period when it appeared that the magazine might have to cease publication for the duration of World War II.

STAN FINGERHOOD GIVING OUR LAYOUT DIAGRAM HIS APPROVAL

JOHN HOWKINS, OUR MANAGING EDITOR

CARROLL BOYCE, FORMER GENERAL MANAGER AND NOW EDITORIAL EDITOR

DICK MOONEY GIVES SOME PICTURES A PHOTOGRAPHY EDITOR'S FINAL INSPECTION

SHOWI
Left to
Sillers,

FIVE YEARS . . .

Anniversary Staff

During the twenties, T. E. N. grew by leaps and bounds into the enviable position of being the outstanding technical undergraduate journal in the country. As it thus gained in stature, it lost in circulation. And its circulation among the undergraduates was not enhanced by the appearance of the *Voo Doo*, M. I. T.'s challenge to the *Harvard Lampoon*. It soon became apparent that students are far less willing to spend the time, much less the twenty-five cents, reading technical articles than reading undergraduate humor sprinkled with the best of *Punch* and the *New Yorker*. In an ill-starred attempt to combat this shortcoming, the magazine gradually turned to articles of an even more technical nature in order to increase the appeal to alumni and outsiders. Let it be recorded, however, that this was not done without considerable success, so that even today the main part of the circulation is among other than undergraduates.

This policy, though, brought T. E. N. into almost direct competition with *The Technology Review* in the technical field, without T. E. N. being able to offer the many features about Tech alumni which so greatly enhances the value of the *Review* to Tech graduates.

Supported by this outside and relatively stable circulation, and aided by the Tech Engineering News Fund, T. E. N. survived the depression years almost with ease, while other magazines fell by the wayside. For the establishment of this fund as well as for its founding, T. E. N. owes thanks to *The Tech*. At the time of the separation *The Tech* had a cash surplus which was divided between itself and T. E. N., and this money was used to establish a fund which could provide emergency capital in hard times. Over the years this fund has been increasing almost steadily (except, of course, for the early thirties) for the profit on each volume is put into the fund.

It was thus that T. E. N. maintained itself up to just about one year ago at this time. At that time T. E. N., like practically all other college publications, was hit and hit hard by the draft and the calling out of the Enlisted Reserve. Because of this it was feared that the magazine would not be able to continue to publish for the duration. In order, however, that it not die completely, a temporary wartime set-up was instituted with a provisional constitution. This placed control in the hands of three men who were to serve as an executive committee to handle the affairs of the magazine during its period of dormancy. It was not long, however, before two of the three appointed found themselves in the Armed Forces. The third, finding that the job of closing up the magazine would be too arduous, decided to try to recruit a full staff and to continue publication. With the nucleus collected

(*Continued on page 280*)

EDITOR-IN-CHIEF CURT BECK GRINDS OUT A LETTER

THE LITERARY STAFF MAKES A FINAL INSPECTION
Left to Right: Bangser, Reid, Fisher, Fonken, Beck, Bongiovanni (Back Row)
Left to Right: Wadel, Sisson, Mooney, Fingerhood (Front Row)

JOHNNY HOWKINS DRAWS 'EM IN AT THE SMOKER

HERB KAEWERT "BUGGERING" THE BOOKS

All photos by T. E. N.

SHOWING THE BUSINESS STAFF
Left to Right: Martin, Scanlan, Lally, Dostal, Sillers, Moulds (Back Row). Kaewert (Front Row)

CURT BECK AND JOHNNY HOWKINS EXTOLLING OUR MERITS

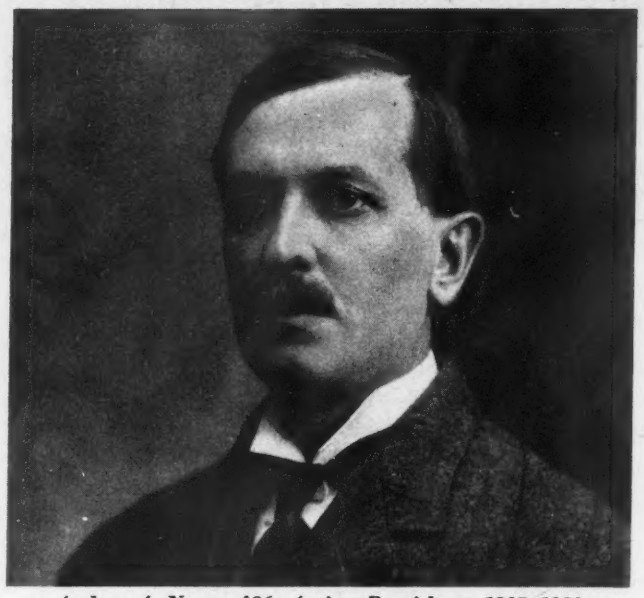
HISTORY OF TECHNOLOGY

(*Continued from page 269*)

The details form an interesting chapter in itself and especially the dramatic climax when the last individual release was obtained with less than twenty-four hours to spare before the expiration of the option of purchase by the New England Mutual Life Insurance Company. The sale was consummated and old Rogers, and Walker as well, which had been leased to Boston University, were torn down to be replaced by the fine new New England Mutual Building. A relic of old Rogers in the form of one of the stones from the famous Rogers steps has been incorporated with suitable inscription in the wall of the new swimming pool building and a grill from old Walker is being preserved by the Architectural Department.

The athletic facilities in the top floor of Walker Memorial soon proved inadequate and the first relief came when the hangar erected during the first world war became the "hangar gym" when the war ended. It passed out when its place was needed for a new research building in the present war. Later additional buildings include the Barbour Field House in 1934, the boat house in 1922, the Sailing Pavilion in 1936, the Briggs Field House in 1939 and the Swimming Pool in 1940.

Technology has had distinguished presidents: 1865–1870, William Barton Rogers; 1870–1878, John D. Runkle; 1878–1881, again Rogers; 1881–1897, Francis A. Walker; 1897–1900, James M. Crafts; 1900–1907, Henry S. Pritchett; 1907–1909, Arthur A. Noyes, '86; 1909–1920, Richard C. Maclaurin; 1920–1923, Administrative Committee of Faculty; 1923–1930, Samuel W. Stratton; 1930 to date, Karl T. Compton. Rogers, for whom the old and new Rogers buildings were named, had the glory of founding M. I. T. Runkle was the dear, kindly Professor of Mathematics who took over for eight years while Rogers' health was poor. A dormitory unit carries his name. Walker did a wonderful job of stimulating the growth of the Institute and under him Technology may be said to have reached maturity. It was at the end of Walker's first year that there came the sudden tragic death of Rogers, who was participating in the graduation exercises in old Huntington Hall on May 30, 1882. Walker's death also was almost equally tragic as he, while apparently in full vigor, passed away



Arthur A. Noyes, '86, Acting President, 1907–1909

in his sleep one night in December 1897. His name was commemorated by the old Walker Building and now by the Walker Memorial. Professor Crafts of the Chemistry Department tided the Institute over for three years and a dormitory unit perpetuates his name. Pritchett contributed much to student activities and to the enrichment of student life, and it is most fitting that Pritchett Hall in Walker carries his name. It was during his administration that the so-called Harvard merger plan of the presidents of Technology and Harvard nearly succeeded. This was another exciting chapter in the history of the school but too long for details to be told here except to say that the opposition of the aroused Technology alumni was perhaps the biggest factor in bringing about its defeat. Since then there has been no attack on Tech's independence. When Dr. Pritchett resigned in 1907 the Chemistry Department again was the source of the world renowned Noyes to carry on for two years.

Maclaurin was the man who loosed the fetters that hampered the growth of the old Technology and created

(*Continued on page 286*)

Elihu Thomson, March '20–June '21
Acting President
November '21–January '23

Richard C. Maclaurin
President, 1909–1920

Dr. Samuel W. Stratton
President, 1923–1930

THE PUBLIC LIBRARY
THE CITY AND COUNTY OF DENVER
DENVER, COLORADO

Zone 2

MALCOLM GLENN WYER
LIBRARIAN

April 4, 1944

The Tech Engineering News
Walker Memorial
Cambridge A, Mass.

Gentlemen:-

We have not received any issue of your paper since v.25 no.1, for October 1943. We regret this and wonder what the cause is?

Have you suspended publication? We hope not, for then there will not be any more editorials like the one in the October 1943 issue!

We also trust you haven't gone all mercenary and are refusing to send us your sheet unless we pay you for it. As we have a complete set, this course would break our hearts, as well as destroy the illusions about your fine generosity which we have cherished all these years.

We also flatter ourselves that it is to your advantage to be seen on our shelves. We, being the largest public technical library between Chicago and the West Coast, feel that way about ourselves. Westerners are supposed to be boastful, aren't they? We - like all public libraries-are poor, we hasten to add, lest you turn our importance into an argument for spending money!

We don't wish to be small, niggardly, mean or parsimonious, but, if, in the words of the business man, "you can see your way clear" to continue sending us your valuable and lighthearted journal free, it will rejoice our souls and remove one headache from our brows.

Pardon the lack of "librarianly" dignity in this epistle, but it's the first day of spring and we're in the same sort of mood your editor was.

Very truly yours,
Margery Bedinger

Margery Bedinger, Chief
Science & Engineering Dept.

MB/gbd

THE TECH ENGINEERING NEWS

"PROFESSIONAL JOURNAL OF THE UNDERGRADUATES"
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ROBERT M. GOULD
GENERAL MANAGER
CURT B. BECK
EDITOR-IN-CHIEF
JOHN S. HOWKINS, JR.
MANAGING EDITOR
HERBERT R. KAEWERT
BUSINESS MANAGER

ADDRESS ALL COMMUNICATIONS TO
THE TECH ENGINEERING NEWS
CAMBRIDGE 39, MASS.
TELEPHONE TROWBRIDGE 1300

May, 1944

Miss Margery Bedinger
Denver Public Library
Denver 2, Colorado

Dear Miss Bedinger:

Many thanks for your jovial letter of April 4th. It isn't often that one has the pleasure of receiving such a letter from such an august person as a chief librarian. And having just flunked an examination when I first saw your letter, I was in roughly the same humor as when I wrote the October editorial. I may say, too, that I was flattered that anyone with presumably more intelligence than the average M.I.T. undergraduate moron would bother to read it.

As to why your magazines stopped coming (and be assured that we have not suspended publication), it was like this. At the time we stopped sending you copies I was in the driver's seat running this "sheet" as you call it, and being of a patriotic nature it seemed to me that in view of the paper shortage, which still continues by the way, it would have been a nice gesture on your part to have sent us at least a little piece of paper as token payment for the fairly large volume of high class paper you were expecting from us. Really, you know, in these war days you can't expect us to go around distributing critical materials to just anybody.

However, we are, or try to be, fair in our dealings, and in view of the fact that we would have to shell out a considerable sum in return for an evening's entertainment at most any of the town's beer joints, we figure that you have something coming to you for all the enjoyment which your letter provided.

We are looking forward to many more letters from your effervescent pen and unpredictable typewriter.

Sincerely,
Carroll W. Boyce

Carroll W. Boyce, Editorial Editor
(Formerly General Manager)

P. S. The special rate to libraries is still $1.20 per year, to all other takers, one-fifty per whack.

THE TECH ENGINEERING NEWS

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FREEDOM OF THE PRESS

Freedom of the press is a flaming sword: hold it high, use it justly, guard it well. Those words have become familiar to many through the medium of radio. They are spoken each Tuesday night by "Steve Wilson, Managing Editor of the 'Big Town Illustrated Press,'" at the opening of Rinso's "Big Town" program.

And today more than ever they should be cause for reflection by every thinking American. In these parlous times the shifting sands of international diplomacy and political and military expediency have brought about a reinterpretation of the meaning of the phrase "freedom of the press." No one fully cognizant of the military necessities of war could reasonably argue that certain restrictions on freedom of the press are not vital to the prosecution of the war. Yet an aroused public must recognize that any unnecessary restrictions on the press constitute one of the main threats to their individual freedom, and they must be eternally vigilant in their defense against undue encroachments.

Freedom of the press in America stems from the famous trial of Peter Zenger, at which time this principle was established as one of the cornerstones of the "American way of life." Ever since Zenger's time this principle has been fostered, this freedom has been increased. This trend has been reversed only during periods of war, and then an alert nation has assured the return of full rights after the emergency has passed.

But never have war-time restrictions been extended as they are being extended today. This being more in the nature of a total war than any heretofore experienced by this nation, it is perhaps reasonable that a lesser degree of freedom is permissible than in previous wars. Yet it is becoming ever more apparent that "censorship" of the American press is no longer being confined to the military field. And when "military censorship" assumes the character of censorship for reasons of political expediency, it is high time that the public begin to ask why, and if a good and sufficient reason is not forthcoming, to do something about it.

Very recently no less a person than New York's Governor Tom Dewey made a very serious charge on this score: "When we find the State Department requesting the British censor to suppress political news sent to American papers by American correspondents abroad, it begins to amount to a deliberate and dangerous policy of suppression of the news at home." Coming from such a high source a statement of this kind could not be unfounded.

If this type of thing is actually going on, are the American people going to take it lying down? It is clearly within their *present* power to see to it that these things do not continue. But if such abuses are allowed to go unchecked, it may not long be within the power of the people to correct them.

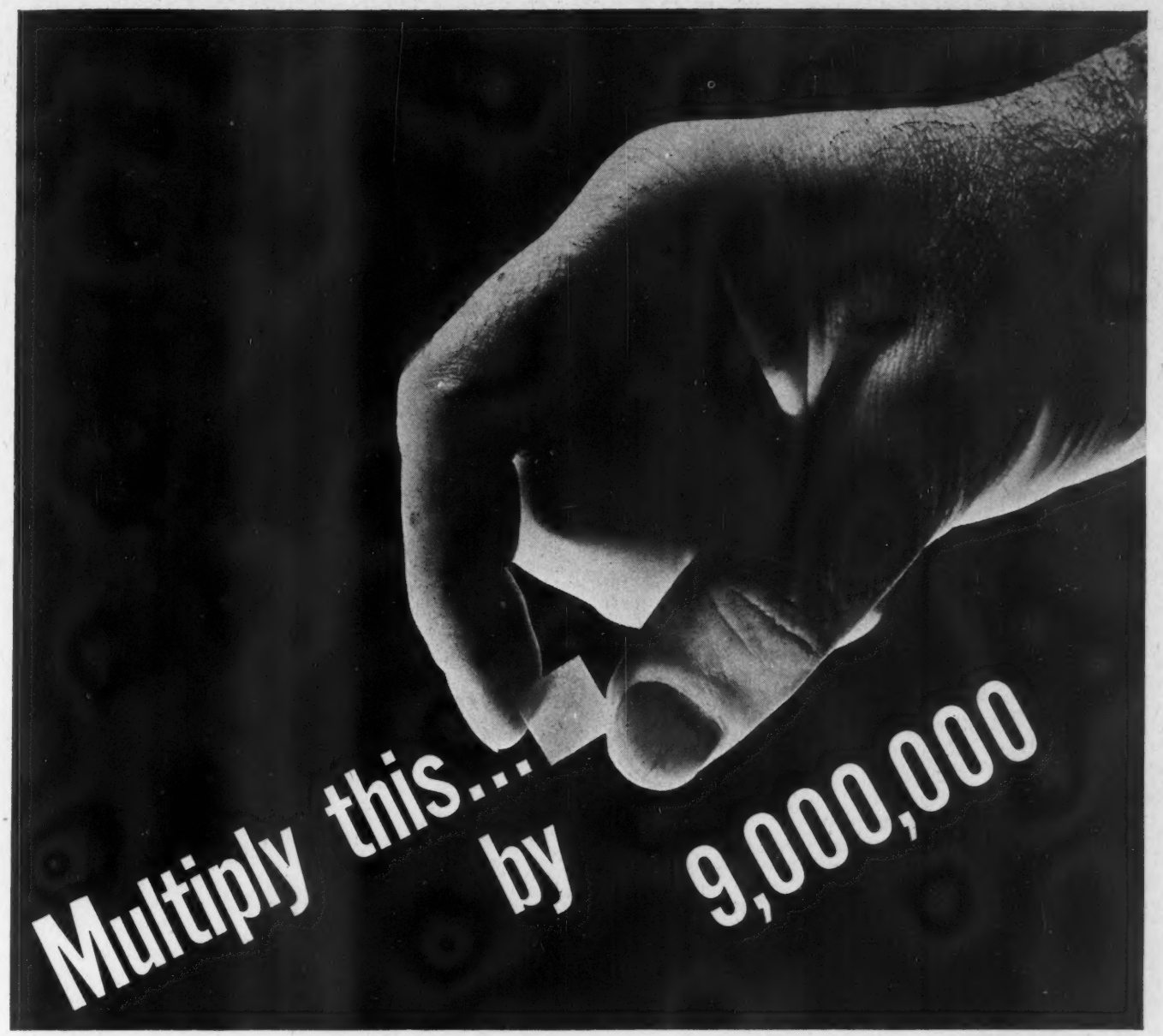
Just this, it would seem fair to infer, was what Dewey was talking about on the occasion of his forty-second birthday when he pressed more specific charges of the handling of the news of the Teheran Conference, United Nations disunity, and the shooting down by their own troops of twenty-three American transport planes, when he said that "People cannot fight a war with blinders on their eyes."

The power of the American nation is such that with her allies she might be victorious in the war against the Axis even with blinders on her eyes. But this war against the Axis is only one manifestation of the real war which is now in progress. It is war for an ideal, for a principle. The ideal, the principle, of individual determination is that for which we fight. The right to live under Lincoln's "government of the people, by the people, and for the people," rather than the totalitarian "government of the people by the government, and for the government."

Americans have been taught from the cradle to rely upon the integrity of the press, and this is as it should be, but if the press is suddenly forbidden to print some part of the news (other than such news the release of which would be inimical to the war effort) it will have a disastrous result. This for the reason that people in the habit of forming opinions based upon what they read in the newspapers will continue to do so, but will be denied information essential to making an intelligent decision.

A threat to the freedom of the American press is a threat to the freedom of all Americans, and thinking people must not allow this threat to pass unchallenged. Unchallenged? Nay, they must not allow it to pass unbeaten. And remember, it is within your *present* power to see to it that it does not pass unbeaten.

C. W. B.



. . . a wartime problem in Engineering

THIS is a quartz crystal. Its job is to hold an airplane or tank radio exactly on its assigned wave length—so fighting men can get messages through quickly, clearly.

Under pressure of war's demands for immense quantities of radio equipment, Western Electric engineers have helped to revolutionize crystal production techniques. Consider these problems:

Each of these little wafers is cut, ground and lapped to almost incredible tolerances;

Each one is metal plated in a vacuum;

Each one is mounted on wires so small that many operations and inspections must be performed under a microscope.

Amazing new machines and methods were devised to do such jobs quickly and well—and the crystals are turned out in unprecedented numbers. One of our four shops now makes as many crystals in a day as the entire industry used to make in a year! To date, Western Electric has produced more than 9,000,000 crystals for war.

Mass production of crystals is just one of many fascinating problems that have been and are being solved by engineers at Western Electric—the nation's largest producer of electronic and communications equipment for war.

To speed Victory, buy War Bonds regularly—all you can!

75TH ANNIVERSARY

Western Electric

IN PEACE...SOURCE OF SUPPLY FOR THE BELL SYSTEM.
IN WAR .. ARSENAL OF COMMUNICATIONS EQUIPMENT.

AERONAUTICAL ENGINEERING

(*Continued from page 260*)

Regardless of the particular electives a man may choose, he will find that graduation from Course XVI prepares him thoroughly in the fundamental engineering sciences, so he may, after some self-education to master specialized details, carry on very successfully as a mechanical engineer, as a structural engineer, or even as an electrical engineer, should postwar conditions require. The originators of the lightweight, streamlined trains were, and for the most part still are, graduates in aeronautical engineering. The originators of the helicopter, as might be expected, were aeronautical engineers, but they had had no courses in the design of that particular machine, since nothing like it existed while they were students. Their basic training provided the foundation on which they built as needed, and it is the aim of the Course XVI curriculum to provide a sufficiently broad base so that able men may seize opportunities in other fields of engineering if they wish, or may advance in the aeronautical field if they but keep abreast of developments made by others. None of the specialties with which an aeronautical engineer must be acquainted has yet been fully developed. All are in a state of flux as research is undertaken or completed on various problems, and as knowledge of new materials and processes improves. The student must, therefore, expect to do more or less collateral reading to keep in touch with developments while he is in college, and he must be prepared to do so after graduation unless he expects to stagnate on a routine job. That men may become acquainted with trade journals and engineering papers, the Institute maintains a branch library in the Daniel Guggenheim Aeronautical Laboratory which all students are encouraged to use.

THE M. I. T. WRIGHT BROTHERS WIND TUNNEL, BUILT IN 1938

Designed to simulate stratosphere conditions up to 37,000 feet and wind velocities of 400 miles per hour, the tunnel has a six-bladed variable-pitch propeller of nearly 13 feet in diameter and driven by a 2,000 horsepower motor. During tests water must be sprayed over the top in order to remove the heat generated by the powerful motor.

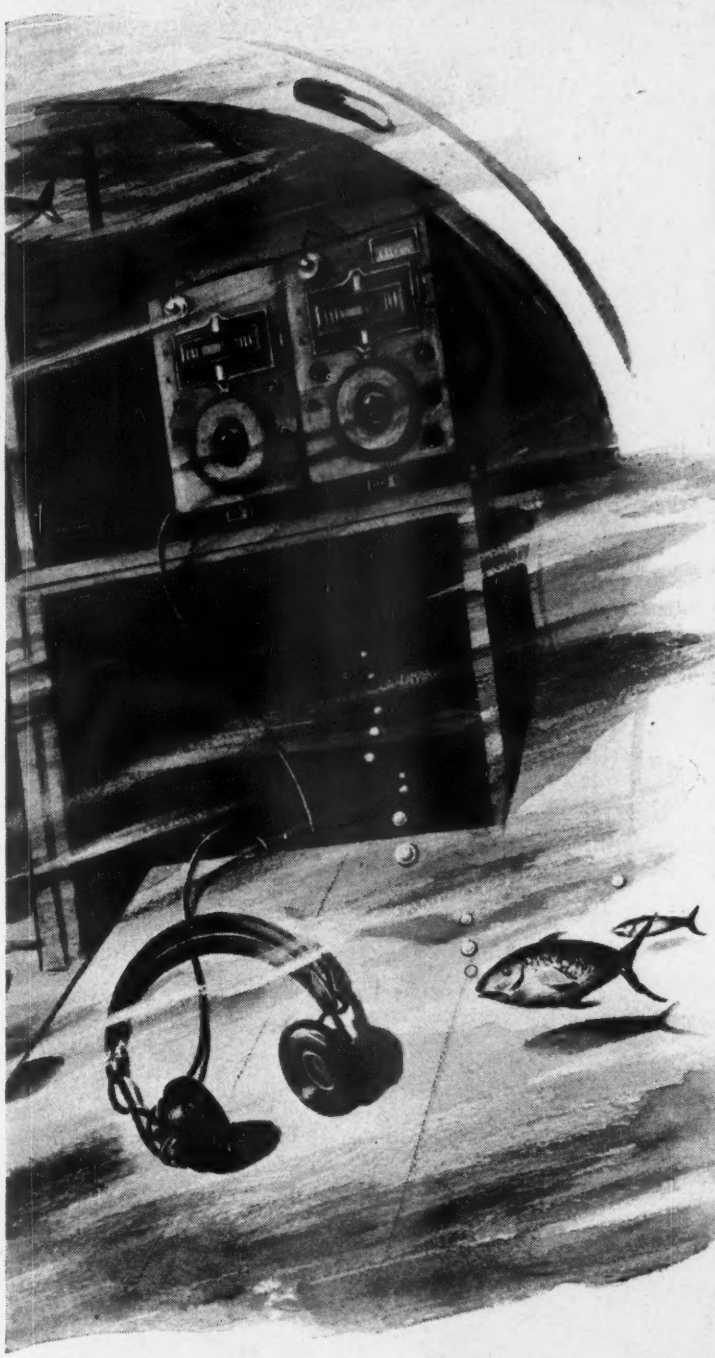
CARGO PLANE OF TOMORROW

Details of the Fairchild C-82 Cargo plane are still secret. It is known that this "truckhorse" of the airways has a cruising range of over 3,500 miles and is being used by the Army to carry everything from tanks to paratroops

Fairchild Aircraft

3 MONTHS IN DAVY JONES' LOCKER

—*And this radio still worked!*



For three months, a radio receiver and transmitter lay at the bottom of the sea. It was part of the equipment of a plane that had accidentally plunged into the ocean during a test.

After three months under water, the radio was brought up and tested. What was found may seem unbelievable, yet it's a matter of record. After the sea water had been drained out, the radio set still worked perfectly.

Unfortunate as the attendant circumstances of this "case history" may be, they afford concrete proof of the invaluable properties and qualities of General Ceramics and Steatite Insulators used in this set.

The fact that Steatite is absolutely impervious to moisture and has no cold flow properties are among the reasons why Steatite is specified by the U. S. Army and Navy.

In the widening use of Steatite Insulators, General Ceramics and Steatite Corporation have been prominent for their increased productive capacity as well as engineering skill in the development of new products and manufacturing methods.

If you have a problem involving insulators whether specialized or standard, our Engineering Department is ready to serve you.

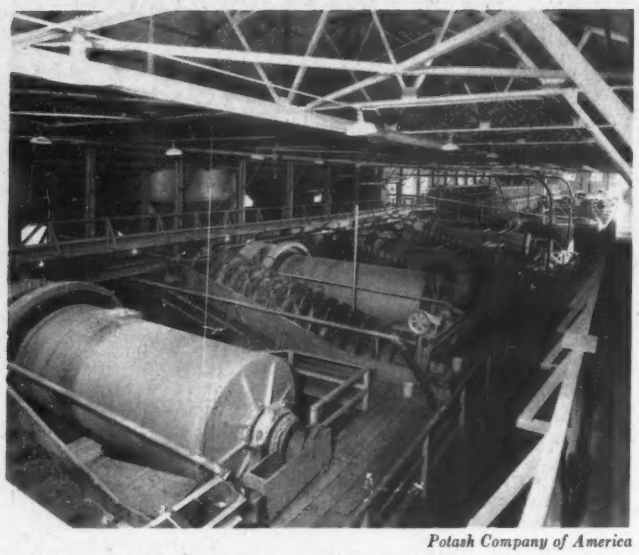
5289

General Ceramics

GENERAL CERAMICS & STEATITE CORPORATION — STEATITE INSULATORS

AND STEATITE CORP.

KEASBEY NEW JERSEY



Potash Company of America

Ball mills and classifiers in the foreground and flotation machines in the background used in potash ore refining

DESERT DISCOVERY

(*Continued from page 263*)

to the waiting railroad cars. Other quantities of the 10-mesh product are sent to the mixing plant where they are blended with concentrated potash to supply demands for a product lower in potassium oxide.

In treating the ore, large quantities of water were required, and because of the location in the desert, water pumped from the mine shaft provided the only source of water. This water had an exceedingly high amount of salts dissolved in it — too much to allow crystallization or water purification with chemicals and still be economically feasible. A study was made and the problem solved by treating the ore by a flotation process.

The 10-mesh material is fed into a large tube mill which works the ore into a heavy pulp of the density required. The pulp is led into "rougher" cells which cause a voluminous froth, the potassium chloride remaining behind as the sodium chloride and other material are lifted away by mechanical means. The froth from these first cells contains desirable elements in small enough quantity to discard. The concentrated potash continues its way through more intricate cells where the process is repeated each time. The froth from these latter cells is later washed over.

The froth or tailings is conducted to an agitation tank where the pulp is warmed several degrees. This is accomplished by hot water jackets surrounding the pulp. This warming results in dissolving out the potash present, which is again separated and thickened.

The thickened pulp passes through a filter where the solids are washed in a tank of salt brine. The pulp is cooled to effect a crystallization of the potash and recovered by filtration.

The high-grade concentrated potash is mixed with the crystalline product and pumped into a series of classifiers which separate the fine material from the coarse.

The coarse material is separated from the fine and led into centrifugals which lower the moisture content to four per cent. The concentrate is then heated in a countercurrent drum dryer until practically all the moisture is driven out. The product is cooled gradually and transported to the warehouses.

The fine concentrate of pulp is added to the liquid from the centrifugals and then passed into a thickener. The mixture passes through filters and drum dryers until the fine dry material is formed. Water is added to the dry materials and the mass pressed into stick-shaped briquets. The briquets are warmed by air for twenty-four hours, and become hard.

The hard briquets are crushed by rollers to dry powder and screened. The powder joins with the coarse concentrate to form the finished product which is stored in warehouses.

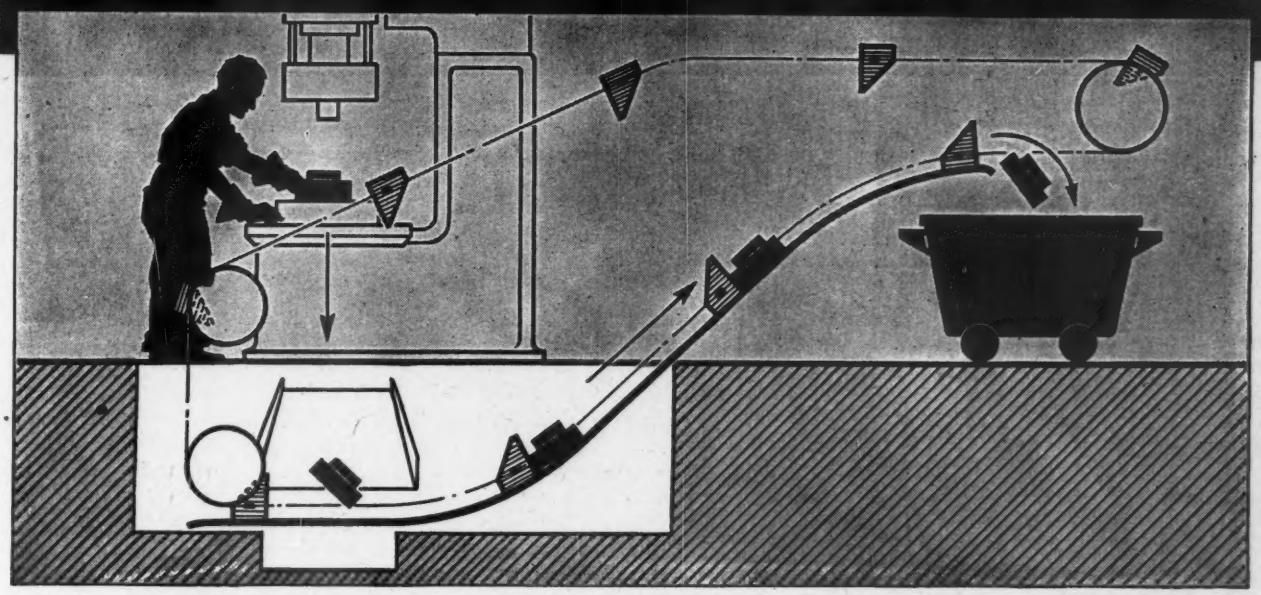
Duck bill type loading machine in a potash mine

Potash Company of America

Nothing remains in the process but to mix the various grades of potash and transport them to the hungry farms of America and the world.

The expansion of the American potash industry has enabled the farmer to buy this necessary fertilizer for less than ever before — even more cheaply than the German peace-time price. Never again will the threat to our farms be raised for a lack of potash. Never will the German scientist boast, as he did in 1918, that had the German armies continued the war for another two years, the lack of potash would have caused our defeat.

How LAMSON Found 24 Additional Workers . . . *without increasing the payroll!*



★ A large Detroit forge plant required two men, besides the operator, on each of 12 hammers, to lift forgings from a pit where they were dropped by the machines, to floor level and into trailer trucks.

Lamson engineers devised the 21-foot pusher flight conveyor illustrated. As an immediate result of this Lamson installation, 24 men were released for more productive work. The confusion, delays and accident hazards of the old manual system were eliminated.

Lamson engineers have prepared a booklet called "Co-ordinated Control," explaining how conveyors and dispatch tubes can be made to integrate and co-ordinate production flow. You are sure to find it interesting. Send coupon for free copy.

LAMSON Corporation

LAMSON
Conveyors & Tubes
Tools for Co-ordinated Control

LAMSON CORPORATION
Lamson St., Syracuse 1, N. Y.

☐ Please send me latest booklet on Lamson Conveyors.

Name..... Class.....

College.....

Address.....

Because of the paper shortage, this booklet can be sent only to those who name their college and class.

FOOD PROCESSING GOES TO WAR

(*Continued from page 265*)

The method of freezing is important. Slow freezing often results in soft, flabby products, poor in color and flavor, and also sacrifices nutritive qualities. Cell structure may be damaged, the elements are separated, and juices leak away on defrosting. In quick freezing, on the other hand, the temperature is lowered so quickly through the zone of maximum crystallization, 32° F. to 25° F., that the elements do not tend to freeze separately. Only minute icy crystals are formed which do little or no damage and the product remains substantially as it was before freezing.

The objective of quick freezing is to place on the table fruits, vegetables, fish, meat, and poultry in virtually the same condition as they were when they came from the orchard, the sea, or the farm. That is why the specifications for Birds Eye products are extremely high. Only farm-fresh, sun-ripened vegetables and fruits, fish fresh from the sea, and poultry at the point of killing are used. There is very little time lag between harvesting and freezing. Sources of supply are close to the freezing operations and the products are processed and packaged without delay.

Various methods of freezing have been used, such as airblast, immersion, and conduction. The process used for Birds Eye Foods employs conduction, which is an exclusive patented process. The previously processed and packaged product is placed between refrigerated plates, and the plates are brought together under controlled pressure which expels the air and prevents dehydration. It brings the low temperature plates in direct contact with the packages, so that no insulating air spaces slow up the heat withdrawal. This operation allows the heat to flow directly and rapidly toward the cold plates from the center of the package.

The process used by Birds Eye has the advantage that there is no damage from brine, as in immersion, and no adherence to any surface, as in bulk freezing by air blast. There is also a saving of labor because there is less handling of the clean, flat packages.

Quick frozen products are distributed from low temperature storage by refrigerated trucks and railroad cars and are placed in cases in retail stores at a temperature around 0° F. These cases are maintained at low temperature with little variation.

Birds Eye was the pioneer in quick freezing, starting in the 1920's, when there was a lack of necessary facilities. Birds Eye pioneered not only the quick freezing process but also the development of the necessary equipment. As a result there has been a new awareness on the part of the public of eating fresh fruits and vegetables for health, and the consumer has welcomed the extra store of vitamins and nutrient quality as a part of her daily diet. Research has shown that vitamins are retained in quick frozen foods, and these products are destined to have an enormous postwar development.

Production of these products is still behind demand. Many new items may be added to the line. Postwar refrigerators will be equipped with low-temperature compartments for holding quick frozen foods. There are at present more than twenty-two thousand retail Birds Eye outlets, which number will increase after the war. More than three hundred million pounds of fruits and vegetables were frozen in 1943, of which the Armed Forces took a large share.

Since Pearl Harbor the processing business has successfully met the demands imposed on it by military needs and at the same time has helped to keep the home front adequately fed. The tremendous demands of the Armed Forces have been met properly, and shipments of unprecedented size have been dispatched to the far corners of the world. When the war is over the processing business will still be taxed to capacity in order to supply the needs of peoples in all parts of the globe.

Looking at the Future

After graduation, many young men will be entering some branch of the metal working industry, using such services and materials as have made the name STEVENS one of the foremost in the minds of engineering men for many years.

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AFTER TWENTY-FIVE YEARS . . .

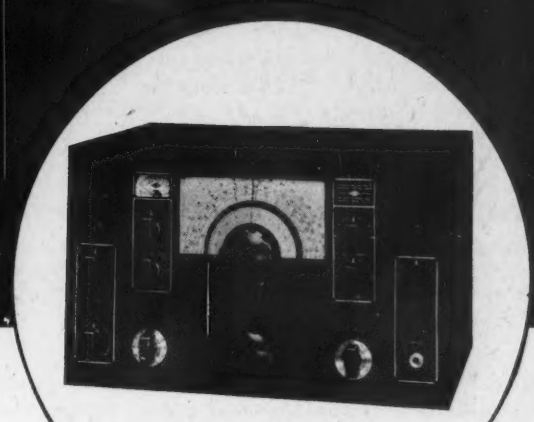
(*Continued from page 271*)

during the summer months the publication was ready to resume regular monthly issues on schedule in October, and these issues have been coming out regularly ever since.

In an effort to recover some of the circulation lost during the previous decade, the magazine underwent a rather radical change of editorial policy, drawing away from the overly technical features and headlining semi-technical stories, school activities and personalities. This policy, combined with a new cover executed in two colors, resulted in a sharp increase in circulation among the undergraduates. There are critics, of course, who will contend that two times zero is still zero, but the establishment of many recent circulation records belies this claim.

It is the hope of the present Managing Board that this forward looking policy will be continued by future Boards, so that the magazine will continue to grow in undergraduate popularity while yet maintaining the high standards of integrity and quality established by THE TECH ENGINEERING NEWS in years past.

With the aid of a vigorous and "idea-minded" undergraduate population, and a little less competition from the *Technology Review* and *Voo Doo*, this aim should be achieved. Certainly it is an aim worthy of the highest endeavor.



NC-100XA

The NC-100XA has gone to war. Under the pressure of the emergency following Pearl Harbor, many stock receivers of the NC-100 series went into action, and served brilliantly. Since then, growing experience has led to a long series of minor changes and improvements, culminating in the superb receiver shown in the photograph above. We cannot show what is inside the cabinet until after the war, but a glance at the front panel will make any amateur recognize an old friend. It is stripped for action and in battle dress, but it is still the old reliable NC-100XA. And like its amateur prototype, this new Navy model is winning an impressive reputation for brilliant performance and absolute reliability.

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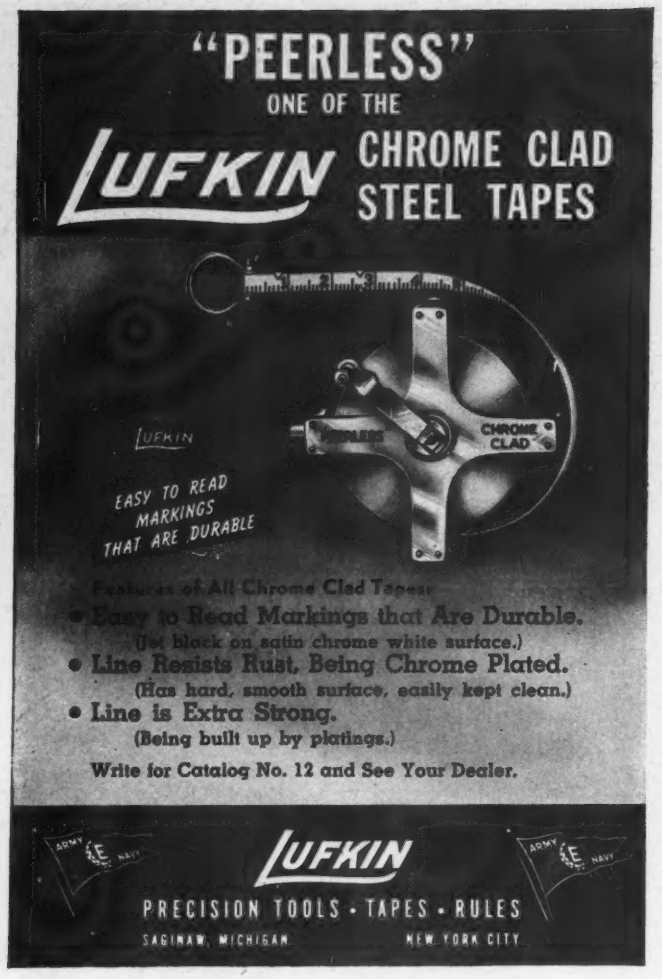
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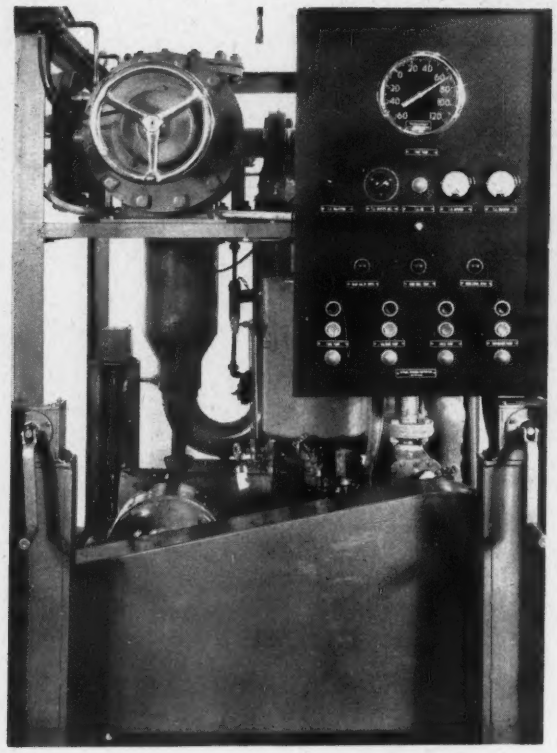


National Research Corporation

High speed 8″ diffusion pump with vacuum tight valves, tight at 10^{-7} mm. Control panap shows temperature of the cold trap, pressure of vacuum and forepressure.

HIGH VACUUM

(*Continued from page 267*)

Applications of High Vacuum

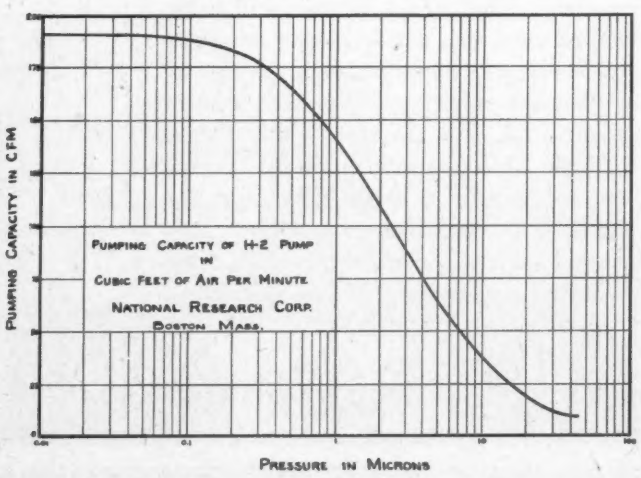
One of the first large applications of high vacuum was distillation. At low pressures, low temperatures can be used to distill, thus eliminating most of the decomposition problems. Thus, materials which never before could be distilled, can be distilled in vacuum. In one type of apparatus, the distillate is evaporated from a hot surface and condensed on a cool one. The space between the surfaces is evacuated to a low pressure, so low that the gas left has no effect on the rate of transfer of the distilled vapor.

At present, the largest commercial application of high vacuum is the ferro-silicon process for producing magnesium from dolomite.[1] In the process dolomite is crushed and burned, after which it is mixed with the proper amount of ferro-silicon. This mixture is made

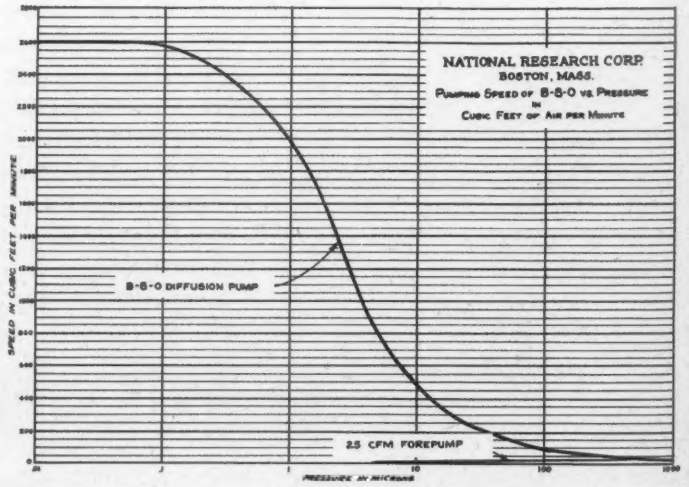
(*Continued on page 284*)

[1] National Research operated one of the first experimental pilot plants for producing magnesium by this method, and vacuum pumping systems designed and built by this company are now used by other large magnesium operators.

Pumping speeds of a 2″ diffusion pump
National Research Corporation


PUMPING CAPACITY IN CFM
PUMPING CAPACITY OF H-2 PUMP IN CUBIC FEET OF AIR PER MINUTE
NATIONAL RESEARCH CORP. BOSTON MASS.
PRESSURE IN MICRONS

Pumping speeds of an 8″ diffusion pump, and a mechanical pump *National Research Corporation*


NATIONAL RESEARCH CORP. BOSTON, MASS.
PUMPING SPEED OF 8-S-O VS. PRESSURE IN CUBIC FEET OF AIR PER MINUTE
SPEED IN CUBIC FEET PER MINUTE
8-S-O DIFFUSION PUMP
2.5 CFM FOREPUMP
PRESSURE IN MICRONS

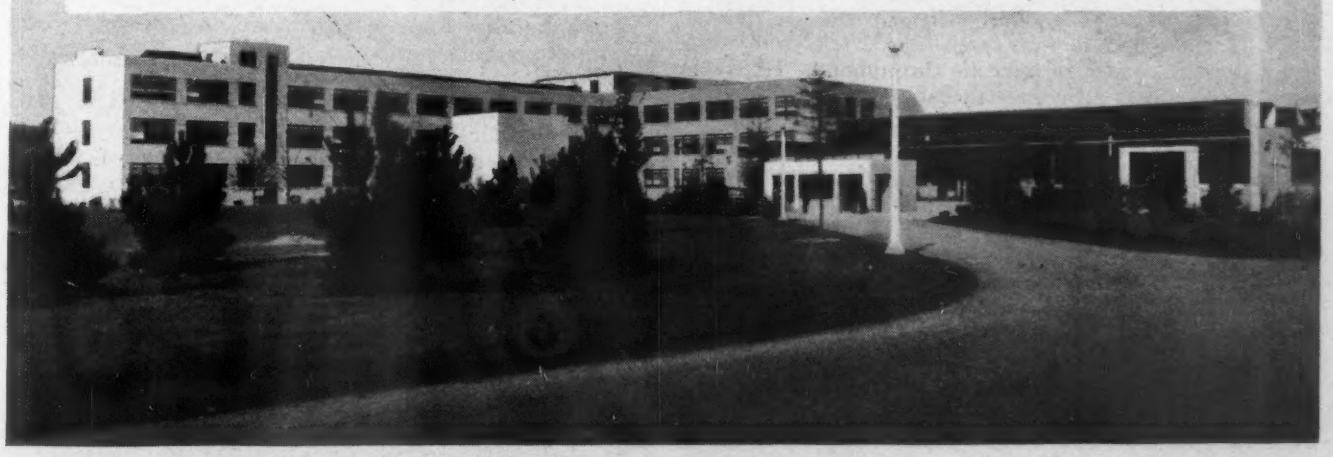
NEW VISIONS for Tomorrow's World

● IT DOESN'T MATTER NOW whether clouds hide the sun, or whether evening shadows fall on the baseball diamond. If the fans in the grandstand see the game so can the modern television camera.

That was not always so; the pre-war television "eye" needed as much sunshine as it could get to illuminate the scene. The same was true of football—final quarters were occasionally "washed out" on the television screen.

But thanks to research, conducted at the RCA Laboratories, a new super-sensitive television camera, rivaling the human eye in its ability to see under conditions of poor light is in prospect for the post-war world. Then, by television you will see every last-minute play of the ball game as clearly as if you were in the stands. Entertainment, sports, news events will pass before your eyes with every detail, every shadow faithfully reproduced.

Today, RCA's research facilities are devoted to providing the fighting forces of the United Nations with the best radio and electronic equipment available. Tomorrow, these same skills will continue to serve America in developing and creating new and finer peacetime products.



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HIGH VACUUM

(*Continued from page 282*)

into briquets and loaded into chrome nickel steel retorts, closed at one end, and standing horizontally in gas or electrically heated furnaces. The open ends of the retorts are supplied with cooling jackets to condense the magnesium distilled over from the heated end. Each retort has an eight-hour cycle, remaining at a pressure of 10–15 microns throughout. The magnesium obtained is the pure metal, requiring no further processing.

High vacuum has been applied to the general metallurgical field, producing metals in vacuum. Almost any metal can be produced by thermal reduction direct from the ore. This will bring into everyday use metals that were too rare and expensive before the war.

Another wartime application is the dehydration of penicillin.[1] Penicillin as it comes from the mold is unstable — its keeping and shipping depending upon its complete dryness. Heat cannot be used, since at high temperatures penicillin decomposes. The penicillin must be kept frozen during dehydration. The higher the vacuum, the quicker the ice sublimes into vapor. The vapor in a one-ounce inch cube at atmospheric pressure occupies one cubic foot; at one micron, the pressure of dehydration, it occupies 25,000 cubic feet. At present there are several large government sponsored plants for the dehydration of penicillin. Very large volumes of water vapor must be pumped under high vacuum. By the same process blood plasma is removed from the blood, at a pressure of 25 microns.

This dehydration process has been applied to foods. Present dehydration processes, using heat, destroy much of the vital "food content" of the foods. By quick freezing the food and then dehydrating under vacuum, a better product is obtained than by other methods.

Coating of lenses, prisms, etc., to eliminate glare and reflection has been made possible by high vacuum. The lenses are placed inside a bell jar, which is then evacuated to a pressure of 10^{-5} mm. Then, by electric heating, magnes um fluoride is evaporated. The magnesium fluoride condenses on the lenses, leaving a coating a quarter of a wavelength thick. This process, begun at M. I. T., has been developed further and industrialized by National Research Corporation in Boston.

Vacuum has opened up an entire new field. Apparatus must be designed to utilize the vacuum. Already valves have been designed which are vacuum tight at pressures as low as 10^{-7} mm. Vacuum has been applied to such processes as cracking and fractionation of petroleum.

After the war high vacuum will make its place as an industry, indispensable to all other industries.

The author wishes to thank Richard S. Morse, '33, President of the National Research Corporation, Boston, Mass., for help in assembling material.

[1] The larger penicillin producers have adopted National Research's new Vacuum Diffusion Process for the dehydration of this new drug.

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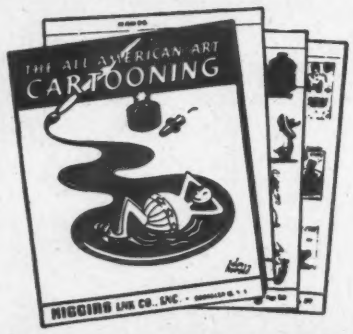

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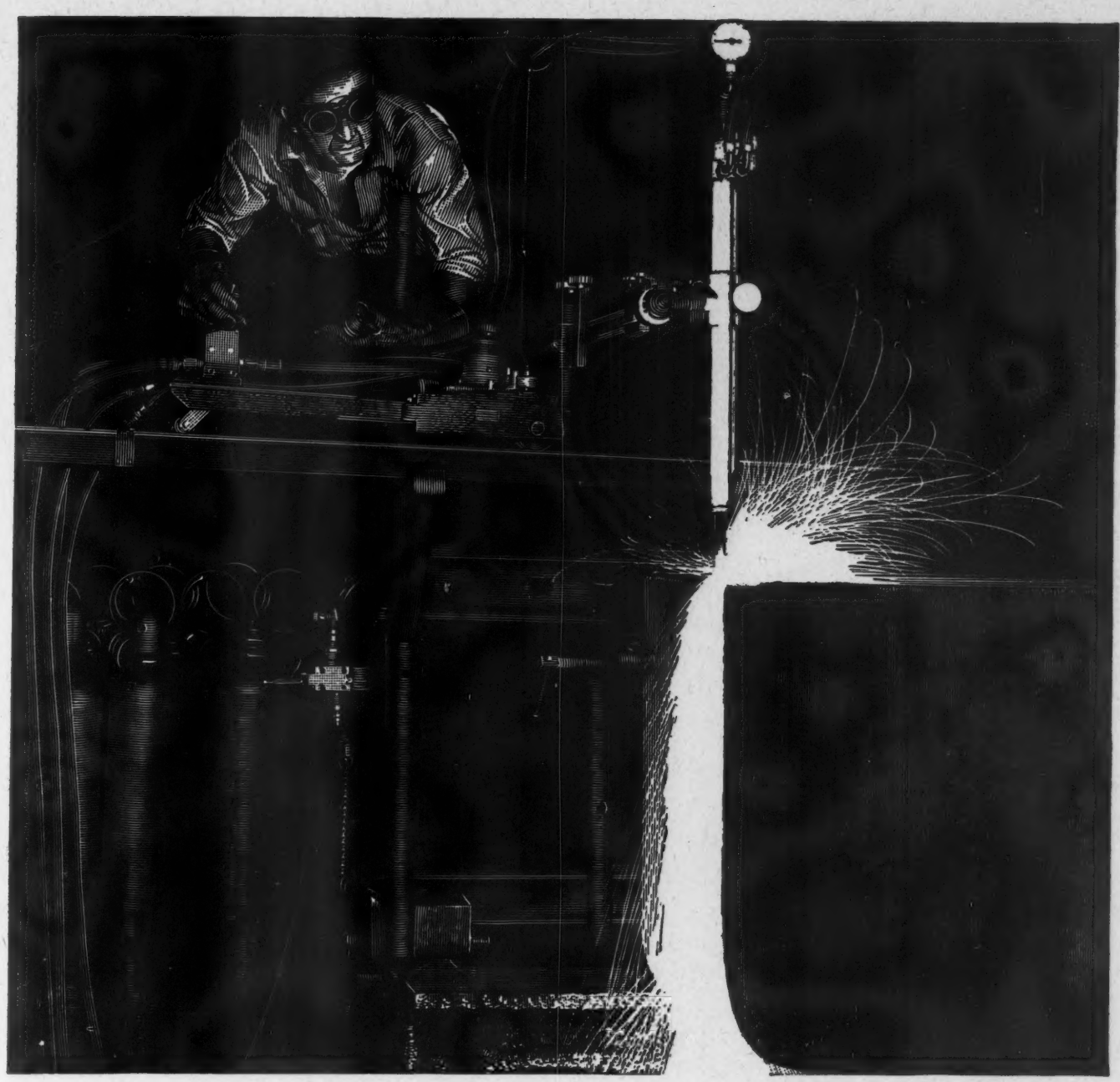
HISTORY OF TECHNOLOGY

(*Continued from page 272*)

the new Technology in Cambridge. He discovered the mysterious Mr. Smith, who later proved to be George Eastman, head of the Eastman Kodak Company. Without the millions provided by Mr. Eastman the new Technology in Cambridge and other later additions could not have been put through expeditiously, or even at all. The Eastman Building 7 bears tribute to his generosity. Dr. Maclaurin passed away suddenly from pneumonia at the very height of his accomplishments. The inscription on the wall in the foyer looking out on the great court really dedicates the new Institute to him. After three years of rule by the Administrative Committee, Dr. Stratton came to administer the ever-expanding school. Again tragedy befell the school when he suffered a sudden fatal heart attack. Now Dr. Compton is performing the herculean task of seeing the Institute through the trying war period and the students of today can see for themselves what a fine job he is doing and appreciate him as an ideal college president.

Many other personages might be mentioned. The first dean of students was Professor Alfred E. Burton, 1902–1922, a most understanding man for whom the Burton room in the dormitories is named. His successors were Professor H. P. Talbot, '85, 1921–1927, and the present deans H. E. Lobdell, '17 and T. P. Pitre. Other deans appeared, including the Graduate Dean H. M. Goodwin, '90 in 1926, recently succeeded by Professor John W. M. Bunker; Dean of Engineering, Dr. Vannevar Bush, '16, 1932–1938, who was also Vice-President (now president of the Carnegie Institution in Washington), succeeded by Professor E. L. Moreland, '07; Dean of Science, Dr. S. C. Prescott, '94 in 1932 until recently retired and his place taken by Professor George R. Harrison; Dean of Architecture, William Emerson, 1932–1938, followed by W. R. MacCornack, '03. In Alumni affairs Ike Litchfield, '85 was the mainspring for many years and O. B. Denison, '11 is still cheer leader and entertainer par excellence at any alumni gathering. William Jackson in the Information Office has grown up at M. I. T. since he first came in short pants to serve as a messenger boy. Major Frank H. Briggs, '81 is credited with being the father of M. I. T. athletics and the Briggs Field and Field House commemorate his name. His work was carried on by Dr. Allan Winter Rowe, '01, a virile citizen whose untimely death ended a most useful career. Horace Ford, now Treasurer, but formerly Bursar, is alleged to have originated the five dollar fine, but "Uncle Horace" is a man to whom a student can always go with his troubles and find relief. In fact this is true of all the officers, teachers and staff at M. I. T. and stressing the doctors and staff of the Medical Department in the Homberg Infirmary. Even freshmen are almost alumni since the Constitution and By-Laws of the Alumni Association provide that any person who attends M. I. T. at least one full term becomes an alumnus and member of the Alumni Association. Thus, all students should not fail to call at the Alumni Office and learn of its facilities and especially how it serves the alumni.

Finally, a prominent personage is still living who has a unique record of continuous connection with M. I. T. from 1865 to date. Immediately after he graduated in the first class of 1868 he went on the staff in the Mining Department. He is the oldest living graduate for whom the century mark is just around the corner. This man is Robert Hallowell Richards, '68.



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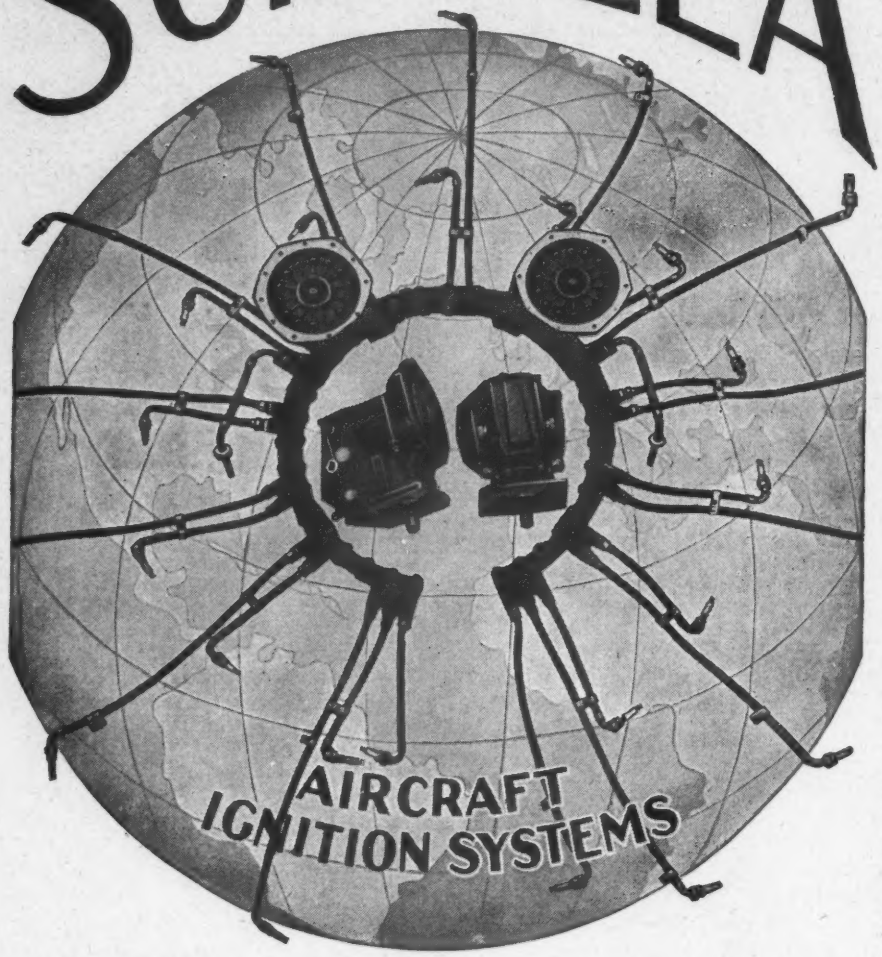

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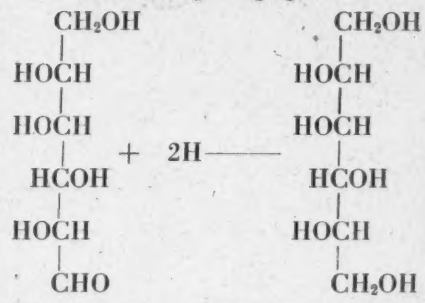
SCOURGE OF SCURVY

(*Continued from page 261*)



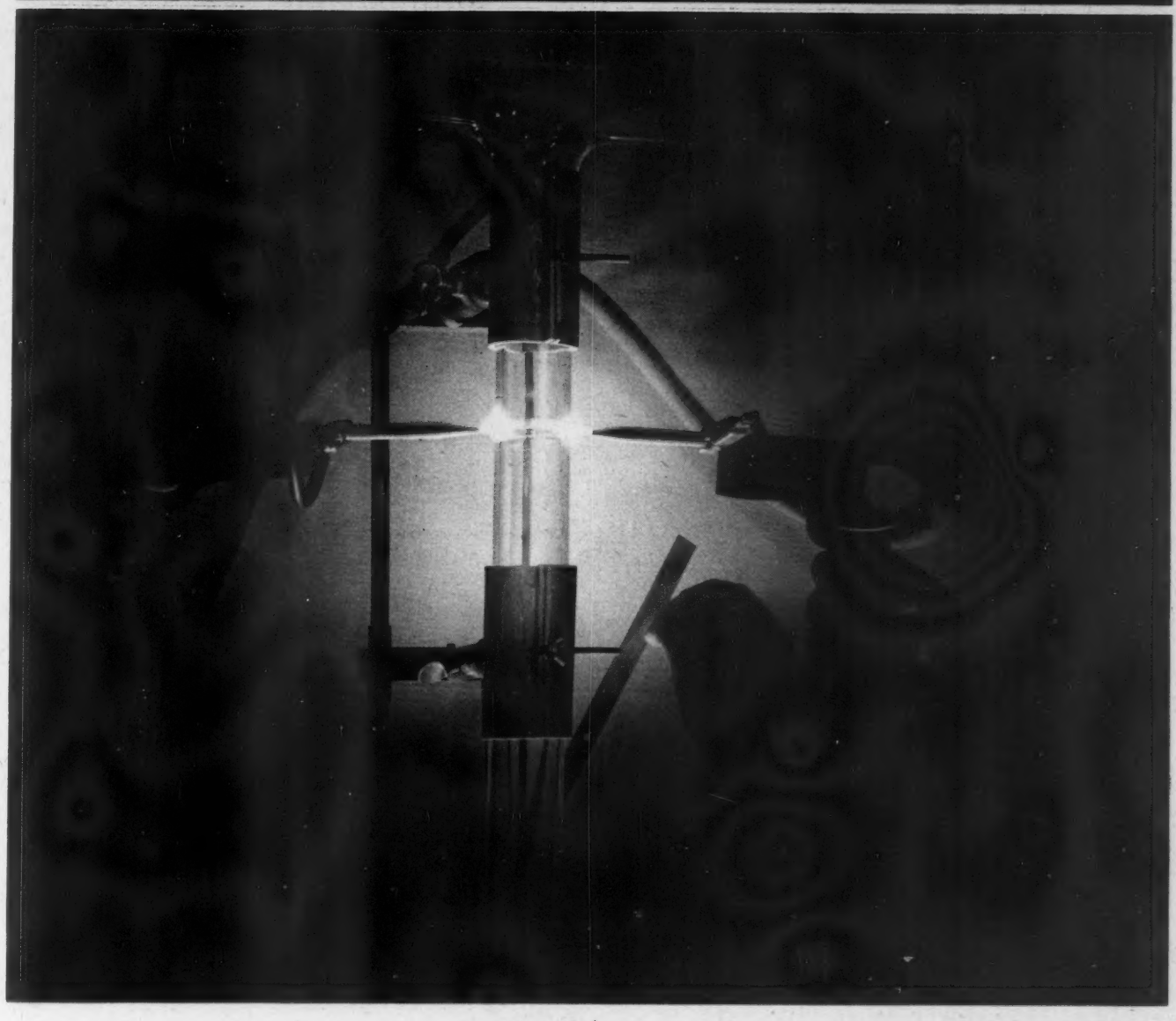
The operation is not continuous, so it must be run in batches. The proper amount of sodium hydroxide and sodium sulfate must be added to the glucose solution to bring the conductivity of the mixture up to that required in electrolytic cells. The material to be used as electrodes in the cells was a problem: the solution was to use pure lead as anode and a lead-mercury amalgam as cathode. A porous diaphragm had to be placed around the anode to prevent the sulfuric acid anolyte from coming into contact with the alkaline catholyte. These technical details disposed of, the reaction proceeds simply: water is decomposed at each electrode, nascent hydrogen being formed at the anode and nascent oxygen at the cathode. The hydrogen reduces the glucose to sorbitol and mannitol and the oxygen reacts to form lead dioxide, a by-product of the reaction.

Various other factors, such as very accurate temperature and mixing control, glass linings for all equipment, vacuum kettles for distillation, and separation of end products were all taken care of adequately. The result is an 85 per cent solution of sorbitol in water, containing glucose and sodium sulfate as impurities. Needless to say, the convenient stereo configuration of the material immediately suggested its use in the synthesis of ascorbic acid.

Once the starting materials have been prepared, the problem remaining is the combination of these materials to give the desired product. As has been previously stated, various persons have tried to use different materials to oxidize the sorbitol to xylose, another intermediate. Two of the most effective methods before Dr. Hockett's method were used by Vargha and Appel. Both used lead tetracetate to do the oxidizing, but differed in choice of a protective agent, one which would protect some hydroxyl groups from being oxidized while doing nothing to the others. Vargha prepared a 1,

(*Continued on page 290*)

Sewing glass with a thread of fire...



FOR a long time industry has wanted a method by which two or a thousand pieces of glass pipe could be joined into a continuous piece. Corning has worked out a high-frequency electrical welding process that literally sews glass with fire.

It has these advantages: 1) It's faster than old methods. 2) It makes a smooth, transparent joint, just as strong as the pipe itself. 3) With the new portable welding equipment it may soon be possible to go into a food or chemical plant and install continuous glass piping right on the job.

Welded glass pipe isn't available now except to certain war plants. But it's another interesting development that points to a greater use of glass when some of the present restrictions on production are behind us. Others are a new type of glass so resistant to thermal shock that it can be heated cherry red and then sprayed with ice water without breaking; "ribbon glass" in sheets almost as thin as cellophane; and a new method by which accurate shapes of almost any size or description never before possible in glass can be quickly formed. Glass is going to play a major role in post-war. And Corning will be there with what it has learned during the war plus a background of nearly a century of glassmaking experience. You can count on it. Glass, the material with a sparkling future, will keep full pace with your own sparkling future as an engineer. Corning Glass Works, Corning, N. Y.

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SCOURGE OF SCURVY

(*Continued from page 288*)

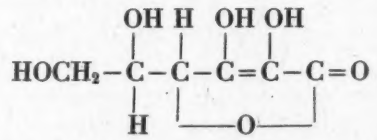
3-monobenzylidene-d-sorbitol which he oxidized and subsequently hydrolyzed to l-xylose. Appel's method consisted of forming a triethylidene compound of sorbitol which, when hydrolyzed, gave a properly protected 1, 2, 3, 4, -diethylidene-d-sorbitol. This was oxidized with lead tetracetate and hydrolysis of the 2, 3, 4, 5, -diethylidene-l-xylose gave the free sugar. The newly developed method uses furfural for this protective function, making the reaction a much feasible one economically speaking, since furfural is considerably more abundant and cheap than the benzylidene or ethylidene compounds.

This step is by no means the end of the synthesis of Vitamin C, for the l-xylose prepared in the last step must still be worked on. A very convenient way of doing this is the cyanide synthesis. The xylose, which is a reducing sugar, is first converted to an osazone with phenylhydrazine.

The osazone is hydrolyzed to form l-xylose osone which is treated with hydrocyanic acid, yielding a cyanide derivative which is then hydrolyzed.

Finally one molecule of water is removed from the substance, giving the desired ascorbic acid, Vitamin C.

If the structural formula is written

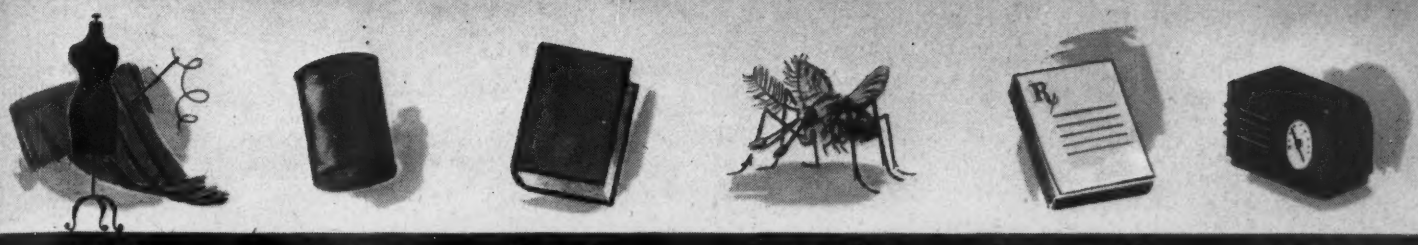


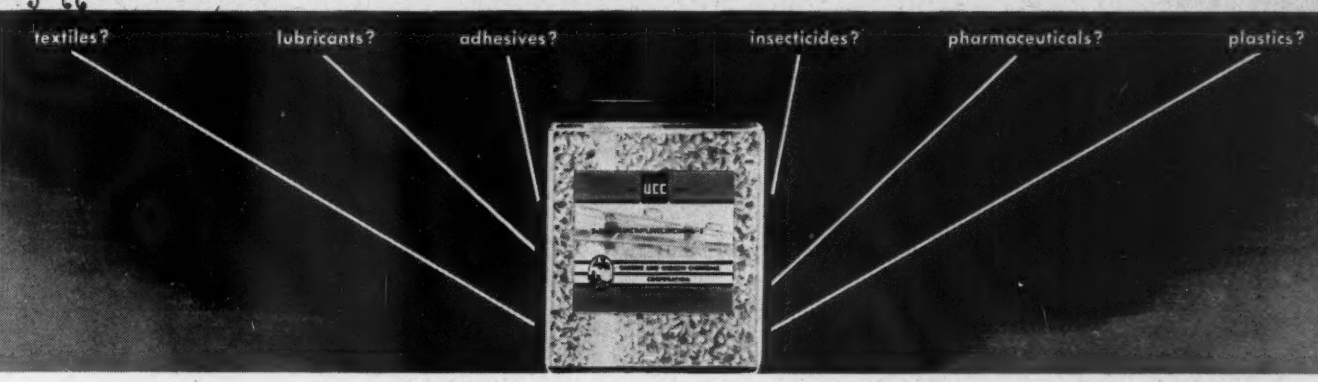
the similarity to the hexoses or six carbon sugars is slightly more apparent.

Thus from a chemical standpoint the long desired all-chemical synthesis has been economically achieved. These are not, however, the only factors which enter into making a process commercially feasible. Much work remains to be done in ironing out the all-too-familiar "bugs" in the process, but we feel confident that with science and technology, research and engineering working hand in hand, the day of success is not far off.

What would you do with some

3,3,5-trimethylcyclohexanol-1?





EVEN *we* know only a little of what you might do with it... yet. Trimethylcyclohexanol (you pronounce it try'-meth'-il-sy'-klo-hex'-an-ohl) is a new industrial chemical by CARBIDE AND CARBON CHEMICALS CORPORATION... made with atoms obtained from common substances, rearranged into molecules that are not known to exist in nature.

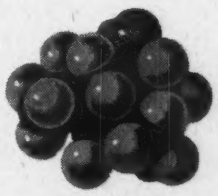
What's this new synthetic organic chemical good for? No one yet knows all of the useful things it might be made to do. If you are technically minded you'll find some of the facts so far discovered in the italicized paragraph at the right. Whatever your interest, you will be glad to know that this new chemical has potential uses in the making of such things as medicines, plastics, lubricating oils, and adhesives.

In their service to industry as incubators for raw materials, the laboratories of this Unit of UCC are continually developing such new chemicals. An almost predictable percentage of them prove to be extremely valuable. Out of hundreds already developed have come scores from which scientists in industry have developed useful products of many kinds.

Some of the chemicals are used to make superior anti-freezes. Others are raw materials for quantity production of vitamins and life-saving drugs. Still others make possible improved cosmetics, plastics, textiles, photofilm, insect repellents, anesthetics... and hundreds of things of benefit to you in your daily life.

Through continuing research which is developing new materials out of common substances, CARBIDE AND CARBON CHEMICALS CORPORATION is helping to make many things more plentiful or more useful. And the research of this one Unit... in that field which often must appear to the layman as "unknown chemicals"... gives you an idea of what the combined research of all UCC Units in many basic fields means to you.

▼



Model of Molecule of Trimethylcyclohexanol

As Trimethylcyclohexanol is one of the newest additions to this family of synthetic organic chemicals, its story is still incomplete. It is an alcohol with a high boiling point (388° Fahrenheit). At room temperature, it is a white solid with an odor like menthol. It dissolves in other alcohols, gasoline, benzene, ethers, and vegetable oils like linseed oil, but does not dissolve in water. It can be supplied in carload quantities if and when the need arises.

Technically minded men and women can obtain information on the properties and uses of more than 160 other products of Carbide and Carbon Chemicals Corporation by writing for Booklet P-5, "Synthetic Organic Chemicals."

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Alloy War-Steel reports for its physical

OWI Photo by Palmer, in an Allegheny Ludlum Plant

TESTING is an integral part of steel production at Allegheny Ludlum mills, because one of the "must" requirements for an alloy steel today is that it possesses—to the full—every one of the special properties desired by the user.

To help prevent failure of a part during operation, amazingly accurate machinery, worth thousands of dollars, is on the job at each Allegheny Ludlum mill, testing each lot of steel before it is shipped out to become fighting parts of planes, tanks, guns, ships or munitions. These steels *must* be right, for in the urgency of battles tremendous stresses are put upon the key parts for which alloy steels are chosen—and those parts must not fail when men's lives are at stake.

It is under such war conditions that Allegheny Ludlum steels have proved their worth. Right now they're helping to uphold the traditions of a free America, so that all of us may retain them in the future. When peace is restored, Allegheny Metal and other alloy steels will take their rightful place again in the enrichment of the post-war world.

But now—today—these metals are supporting the attack. Be sure you are also supporting our fighters, from your place behind the lines. Buy war bonds regularly! Top that ten per cent . . . buy them to the limit of your ability.

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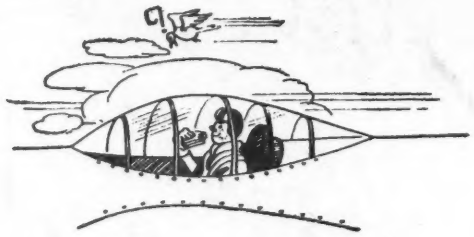
RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD



AUTOMATIC PILOT

FLYING blind most of the time, a pilot has a hard job keeping his plane on its course. An automatic pilot, electrically-driven, allows him to relax occasionally . . . to save his physical and mental resources for the job that may, and often does, lie far ahead.

An electric motor spins 12,000 revolutions per minute to keep the gyroscopic mechanism, guiding power of the automatic pilot, rotating at constant speed. The unit is tightly sealed to insure constant speed of rotation even when the air outside contains many dust particles, or its temperature is very low.

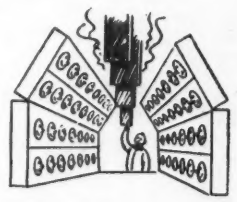
The automatic pilot is able to take over the controls and hold the plane on a predetermined course. Any pitch, roll, or yaw—that is, lengthwise or crosswise tilt or turn of the plane—produces an electric signal in the G-E automatic pilot. This signal is amplified and converted into hydraulic power which moves elevators, ailerons, and the rudder to bring the plane back to its correct position.

FLYING SUITS

WHEN planes land in unpopulated regions, or when fliers have to bail out in the middle of nowhere, there is comfort to a General Electric flying suit. Even when not plugged in, the suits can take rugged terrain, strenuous action, and cold weather.

A short time ago some G-E engineers spent two days and nights in the suits on Mt. Cranmore and Mt. Washington in New Hampshire. They skied, hiked, blazed trails, and camped out in heavy snowdrifts at temperatures close to zero.

After the ordeal, men and suits were doing nicely. The men had kept warm; the suits had withstood the wear; and the electric circuits built into the clothing operated perfectly when they were plugged in.



SPEED DRYING

DRYING time has been cut from six hours to 27 minutes on airplane instrument cases by using the new General Electric infrared Drying Lamps. These lamps are one of the important "little things" that G.E. is manufacturing to speed things up on the production front.

These lamps are being used in many war industries to dry everything from paint on tanks and jeeps to photographic film and the glue on envelope flaps. In addition, some are designed for roving jobs such as drying out important equipment after it has been drenched by floods. Equipment speedily dried is frequently salvaged with little loss. *General Electric Company, Schenectady, New York.*

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